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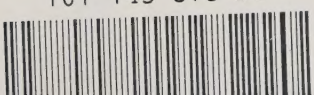

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THE PACIFIC BASIN

By

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FOREWORD

LIKE one of its own typhoons, a great change is sweeping across the Pacific Basin. The South Seas of song and story are passing, if, indeed, they are not already a mere idyll of sun-kissed lands and childlike peoples. Japan has emerged from an age-long isolation to embrace the ideas and institutions of the West. China finds herself torn between those who would welcome a similar change and those who would resist it to the death. Disappointment and disillusionment await the traveller whose expectations have been built upon the pictures left by the writers of fact and fable. Places and peoples from China to Chile have been caught up in the great changes going forward. From the merciful haze of other days—merciful because it hid so much that was brutish and sordid—the Pacific has emerged to our sight as a whole series of problems calling scientist and statesman for help in their solution. For the realities of the day are forced upon us whenever the quiet of an island valley is broken by the hoot of a motor, or the calm of a Pacific dawn shattered by the siren of an incoming steamer. The new order affronts us in the American sewing-machine flaunting its newness on the porch of this native house, or in the strains of the Birmingham gramophone floating out from the interior of that one. The picture palace and the Paris model mock us from one side of the Pacific to the other, and bear witness to the speed and certainty with which the West is standardizing and vulgarizing the East.

The old order of hermit countries and uninhabited islands has gone for ever. The new régime of competition, by placing a premium on utility, has forced these lands into the world economy. Competition, however, means rivalry; and all round the Pacific the nations are regarding one another with

suspicion. The Western assault on the Orient began with Marco Polo, and reached a climax with the opening of the Panama Canal. The coming of the railway, the modern factory and wireless telegraphy, the Kingsford Smith flight from San Francisco to Brisbane, and the voyage of the *Graf Zeppelin* across Asia have all made the Orient feel that security and old custom are alike threatened. The world has shrunk with incredible rapidity; and to ensure its future peace solutions must be found for the new problems caused by the closer contacts that are thus forced on peoples in different stages of civilization and of different religions, races, and environment. East and west of the great ocean are English-speaking peoples who, though obsessed by the problems of their own settlement, are conscious of duties to native races for whose welfare they consider themselves responsible.

For the English-speaking peoples and the native races alike peaceful development of the whole Basin depends upon knowledge of the characteristics of the regions within it, its natural resources, and its inhabitants. This geographical study, designed to give that knowledge, will fulfil my earnest hope if also it enables the dwellers of the Basin, by means of an enlarged ability to interpret the facts of their environment, to sense the overwhelming need for co-operation and intelligent foresight in planning for the future.

To the Institute of Pacific Relations is due my grateful thanks for the opportunity which made a personal acquaintance with the area possible. I hope that the vision of its leaders and their zeal for truth is reflected in my book. Lacking space for the specific mention of all those who have helped me in the collection of materials, I wish to tender my thanks for unlimited and generous assistance.

G. L. W.

LONDON, *October* 1929.

ACKNOWLEDGEMENTS

For photographs illustrative of life and work in the Pacific I am greatly indebted to the persons and institutions set out below. The wealth of pictures offered made the task of selection very difficult; and the reader will easily appreciate the valuable contribution which they make to the presentation of conditions as they are at the present day.

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Who hath desired the Sea—the sight of salt-water unbounded ?
The heave and the halt and the hurl and the crash of the comber wind-hounded ?
The sleek-barrelled swell before storm—gray, foamless, enormous and growing ?
Stark calm on the lap of the Line—or the crazy-eyed hurricane blowing ?

Who hath desired the Sea—the immense and contemptuous surges ?
The shudder, the stumble, the swerve ere the bowsprit emerges—
The orderly clouds of the trade and the ridged, roaring sapphire there-under
Unheralded cliff-lurking flaws and the head-sails' low-volleying thunder ?

KIPLING.

CONTENTS

List of Maps and Illustrations ix

PART I

THE PACIFIC ENVIRONMENT: A GENERAL SURVEY

I. The Pacific Basin 1
II. Climate in the Pacific Basin 18
III. Man in the Pacific 29
IV. Natural Regions: The Hot Lands . . . 35
V. Natural Regions: The Warm Temperate Lands . 41
VI. Natural Regions: The Cool and Cold Lands . 45
Bibliography 53

PART II

MALAYSIA AND THE EAST INDIES

VII. Malaysia 54
VIII. British Malaya and North Borneo . . . 59
IX. The Dutch East Indies 69
X. New Guinea 77
Bibliography 86

PART III

AUSTRALIA

XI. Physical and Climatic 87
XII. Plant Life 95
XIII. Animal Life, Population, Settlement . . . 107
XIV. Economic Survey of the North and East . . 117
XV. Economic Survey of the South-east and South-west 129
Bibliography 150

PART IV

NEW ZEALAND

XVI. Physical and Climatic 151
XVII. Economic Survey 163
Bibliography 176

PART V

THE PACIFIC ISLANDS

XVIII. The Continental Islands: Melanesia . . 177
XIX. Volcanic Groups of the Mid-Pacific: Polynesia 189
XX. Atolls and other Islands: Micronesia . . 208
Bibliography 213

PART VI

ASIA

XXI. The Philippine Islands 214
XXII. Siam and Indo-China 220
XXIII. China 228
XXIV. Manchuria, Mongolia, Tibet, Siberia . . 244
XXV. The Japanese Islands 250
Bibliography 264

PART VII

NORTH AMERICA

XXVI. The North American Side of the Pacific Basin . 265
XXVII. Alaska and the North Coast 269
XXVIII. The Puget Sound–Willamette Valley . . 277
XXIX. The Fraser–Columbia Valley 285
XXX. California 289
XXXI. The Dry Lands 297
XXXII. The Pacific Coast of Central America . . 304
Bibliography 306

PART VIII

SOUTH AMERICA

XXXIII. General Survey of the Pacific Coast . . 307
XXXIV. Colombia and Ecuador 319
XXXV. Peru and Bolivia 325
XXXVI. Chile 331
Bibliography 336

INDEX 337

LIST OF MAPS AND ILLUSTRATIONS

1. The Floor of the Pacific 2
2. Profiles of the Ocean Floor 4
3. Volcanic Zones 8
4. Effects of the 1923 Earthquake in Tokyo . . . 9
5. Marginal Folding 10
6. Trend Lines of Pacific Islands 10
7. Coasts and Coral Building 12
8. Atoll in Section 14
9. The Great Barrier Reef 17
10. Ocean Temperature and Pressure, January . . . 20
11. Ocean Temperature and Pressure, July . . . 22
12. Ocean Currents 26
13. Bornese Fishing Boats 31
14. The Continental Shelf between Asia and Australia . 55
15. Village in Malaya 57
16. Malaysia, Orographical 60
17. Tropical Forest and Timber Getting . . . 63
18. Straightening Rattans, Malaya 63
19. Rubber Plantation, Malaya 64
20. Singapore 66
21. Tin-dredging, Malaya 67
22. Terraced Padi-fields, Java 71
23. Mangrove Forest, Malaya 73
24. Ancient Hindu Temple, Borobudur 74
25. Family Dwellings, Sumatra 75
26. Village in Papua 79
27. Native of Papua 80
28. Stone-age Man in Papua 83
29. Native Life of Papua 85
30. Australia, Physical 88
31. Australia, Rainfall and Winds 92
32. 'Highs' and 'Lows' over Australia 94
33. Australia, Rainfall Reliability 96
34. Deforestation in Australia 99
35. Wheat Harvest in the Mallee 101
36. Distribution of Sheep and Wheat, Australia . . 104
37. Cotton Crop, Queensland 106
38. Australian Aboriginal Types 109
39. Australia, Distribution of Cattle 110
40. Mustering Sheep, New South Wales 111
41. On a Stock Route, N.W. Australia 112
42. Artesian Bore in Central Queensland . . . 114

43. Distribution of Australian Population . . . 116
44. Northern and Central Australia 118
45. The Great Artesian Basin and Central Queensland . 122
46. Cutting Sugar-cane, Queensland 125
47. East Coast of Australia 127
48. The Great Divide, New South Wales . . . 128
49. South-east Australia 130
50. Eucalypt Forest, S.E. Australia 131
51. Valley of the Upper Murray 132
52. Brown Coal Deposit, Yallourn 133
53. Power House, Yallourn 134
54. Tasmania 136
55. King River Gorge, Tasmania 137
56. Apple Orchards, Southern Tasmania 138
57. Pipe Line and Power Station, Waddamana . . . 139
58. Electrolytic Zinc Works, Risdon 140
59. The Murray Valley 142
60. Dethridge Water Meter 143
61. Wool Barges on the Murray 145
62. Carting Wool, New South Wales 145
63. Clearing the Bush, Western Australia . . . 147
64. Western Australia 148
65. Pearling Luggers, Broome 149
66. New Zealand, Physical 152
67. Mount Cook and Southern Alps 155
68. Franz Josef Glacier, Southern Alps 155
69. Mitre Peak and Milford Sound 157
70. Mount Egmont 157
71. New Zealand, Pressure and Winds 158
72. New Zealand, Rainfall 160
73. Forest and Fern Country, New Zealand . . . 161
74. New Zealand, Monthly Temperatures and Rainfall . 162
75. *Phormium tenax*, Taranaki 163
76. Kauri Forest 165
77. New Zealand, Distribution of Sheep and Wheat . . 166
78. New Zealand, Distribution of Cattle 167
79. Wheat Harvest, Canterbury Plains 168
80. Sheep Pastures, Marlborough 169
80a. New Zealand, Population 170
81. Maori Chief 171
82. New Zealand, Value of Production 173
83. Whaling in the South Pacific 174
84. Power Scheme, Wellington 175
85. New Guinea and Continental Islands . . . 178
86. Coco-nut Plantation, Solomon Islands . . . 180
87. Gathering Coco-nuts, Melanesia 181
88. Extracting Copra 185

89. Profile of Moorea, Society Islands 189
90. Sugar Industry, Fiji 191
91. Fiji, Tonga, and Samoa 192
92. Sugar-cane on Trucks, Lautoka 195
93. Native Village, Samoa 195
94. Flume on Sugar Plantation, Hawaii 201
95. Hawaiian Islands 202
96. Oahu and Maui, Rainfall 202
97. Pineapple Growing, Hawaii 205
98. Tahiti and the Atolls 210
99. Philippine Islands, Rainfall 215
100. Plantation of Manila Hemp (*Abaca*) 217
101. Siam and Indo-China 222
102. South-east Asia, Population 223
103. Rice Nursery, Siam 225
104. Planting Rice, Siam 227
105. South-east Asia, Winds and Rainfall 230
106. China and Provinces 232
107. River Shipping, Shanghai 233
108. Farm Scene, China 233
109. China, Cultivated Land 234
110. Canal Scene, China 237
111. Shipping on the Yang-tse 238
112. The Tidal Bore on the Yang-tse 239
113. Trade of China 240
114. Transport in China 241
115. Hong Kong 242
116. Winter Scene, Chefoo 243
117. Mongol Village 244
118. Mongol Lady 246
119. Manchu and Mongol 247
120. Ancient Wall and Modern Railway, Mongolia . . 249
121. Terminus of S. Manchurian Railway, Dalny . . 250
122. Japan and Asia 252
123. Japan, Temperature and Rainfall 252
124. Tea Gardens, Japan 254
125. Bridge of God, Nikko 255
126. Afforestation in Japan 256
127. Japan, Communications and Cities 257
128. Trade of Japan 257
129. Silk Factory, Japan 258
130. Japanese Porcelain Painter 259
131. Loading Silk, Yokohama 260
132. Steel Works, Yawata 261
133. Cotton Factory, Tokyo 263
134. North America, Physical 266
135. North America, Rainfall 266

136. Railway in the Rockies 267
137. The Northern Rim of the Pacific Basin . . . 270
138. Gold Mining in the Yukon 272
139. Dawson 273
140. Totem Pole, British Columbia 274
141. Salmon 'Running', Skeena River 275
142. Salmon Cannery 276
143. Puget Sound, Fraser and Willamette Valleys . . 278
144. Saw-mill and Box-factory, Oregon 280
145. Douglas Fir Forest 281
146. Vancouver 282
147. Power Plant and Pulp-mill 283
148. Harbour of Victoria 284
149. Upper Fraser River Valley 287
150. Fruit in Okanagan Valley 288
151. California 290
152. Californian Landscape 291
153. Oil Wells, Los Angeles 292
154. Orange Groves, San Joaquin Valley 293
155. San Francisco 294
156. Vegetable Growing, California 295
157. Port Wilmington 296
158. Colorado and Mexico 298
159. Cattle on the Dry Lands 299
160. Cactus in the Great Desert 300
161. Canyon of the Snake River 301
162. Elephant Butte Dam 302
163. Indian *Pueblo* 303
164. Panama Canal 305
165. Western South America, Physical and Winds . . 308
166. Western South America, Cross Sections . . . 309
167. Cerro Puntiagudo, Andes 310
168. Bolivian Plateau 311
169. South America, Rainfall 312
170. Chunchu Indians of the Montana 315
171. Central Railway, Peru 317
172. Colombia and Ecuador 318
173. Cacao Plantation 323
174. Peru and Bolivia, Mining Regions 326
175. Indian and Llama 327
176. Guano Island 328
177. Sunday Market in Peru 329
178. Chile 332
179. The Harbour, Callao 334
180. Nitrate Oficina, Chile 335
Regional Map of the Pacific . . . *Back end paper*

PART I

THE PACIFIC ENVIRONMENT: A GENERAL SURVEY

Chapter I

THE PACIFIC BASIN

None of the world's oceans casts such a glamour of adventure over us as the Pacific, none has so stirred man's imagination, and none affords more enticing problems to the student. From the theory that this vast depression in the earth's crust was left when the semi-liquid moon was torn from the earth-mass, to the riddle of the formation of those curious islands known as atolls, is one great field for inquiry and speculation. Turning from the problem of the changing earth to fix our attention upon human life in the Pacific, we find just as wide a field awaiting investigation. Whence came those wandering peoples whose descendants are found all over the spacious archipelago of the Pacific? Are they but the degenerate remnants of great former civilizations? What stirring dramas of history lie behind those relics of Hindu colonization in Java and Sumatra? How came the massive monuments at Easter Island to be placed in that lonely outpost? Why was that 'Venice of the South Seas' at Ponape in the Carolines deserted? By what marvellous skill in navigation did the old Polynesian pilots lead their migratory bands over the trackless ocean? These, and many other questions at whose answers we can but guess at present, show that in many ways we are only beginning our acquaintance with the greatest of oceans.

This vast expanse of water—longer, wider, and deeper than any other—covers an area larger than that of all the land above sea-level; that is to say, its waters extend over one-third of the whole surface of the earth. The volume of its

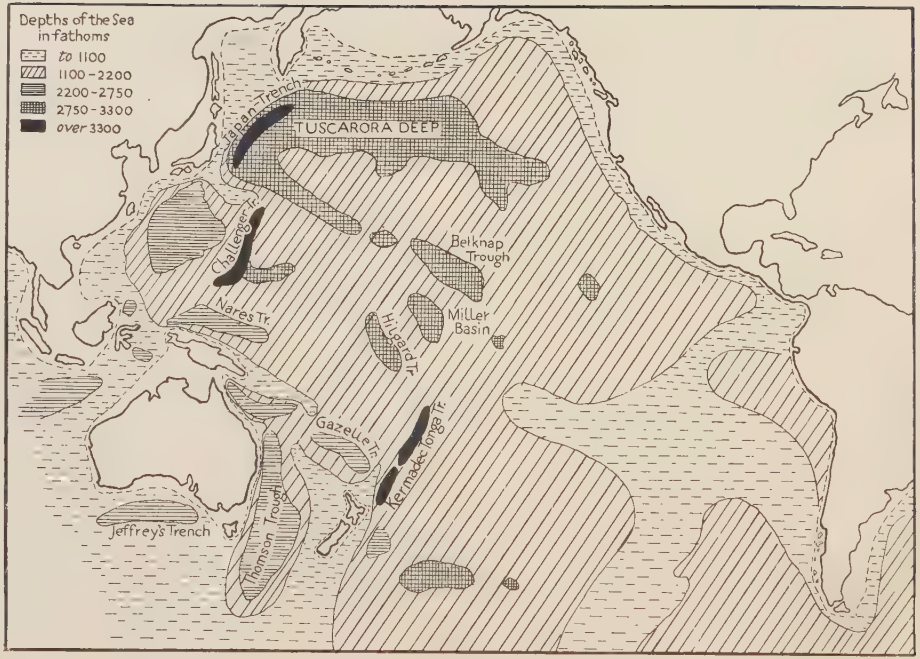

FIG. 1. THE FLOOR OF THE PACIFIC

waters is twice that of the Atlantic, and its extent is almost too vast for the mind of man to comprehend. From the Philippines to Panama means a voyage of ten thousand miles, and the distance from the Antarctic to Alaska is almost as far. The coasts washed by the Pacific ocean are longer, its enclosing mountain walls higher, and its submarine valleys deeper than any others in the world. Its enormous basin holds most of the world's islands, and it is ringed about by a line of fire consisting of most of the world's active volcanoes.

The land surface which drains into the Pacific is, on the other hand, comparatively small. It is but one-fourth of the size of the corresponding Atlantic area. It represents an area less than three times the size of Australia; but on it live one-third of the world's people. The eastern wall is formed by the mighty cordillera known as the Rocky Mountains in North America, and as the Andes in South America, a great series of earth folds stretching for eleven thousand miles, and sloping steeply to the ocean floor. The coastal plain on this side is, consequently, a mere ribbon; while the streams are small and of little importance.

The divide between the Pacific and Arctic basins is broken by a narrow gap of less than forty miles at Bering Strait; and on the Asiatic side it runs away south and west through the Stanovoi, Altai, Tian Shan and Tibetan highlands to climb gradually to the mountain core of Pamir, the 'Roof of the World'. This great curve of mountain wall encloses the Pacific slope of eastern Siberia, Manchuria, China, and Malaya, with its four great valleys of the Amur, Hoang-ho, Yang-tse, and Mekong, comprising an area as large as South America. Behind the river valleys stand the highest and most extensive plateaux on the globe; and, as a background to the fertile valleys of China rise the mysterious highlands of Tibet and Mongolia, with the towering heights of the Himalayas and the vast ranges of the Tian Shan, well named the 'Mountains of Heaven'.

The mountain fold which forms the Pacific-Indian watershed now stretches south and east like a gigantic sea-serpent with its undulations sometimes above water, as in the Sumatra-Java-Timor chain, and sometimes submerged as in the deeps between these islands. This fold leaves the sea to the north of Australia and becomes the height of land known as

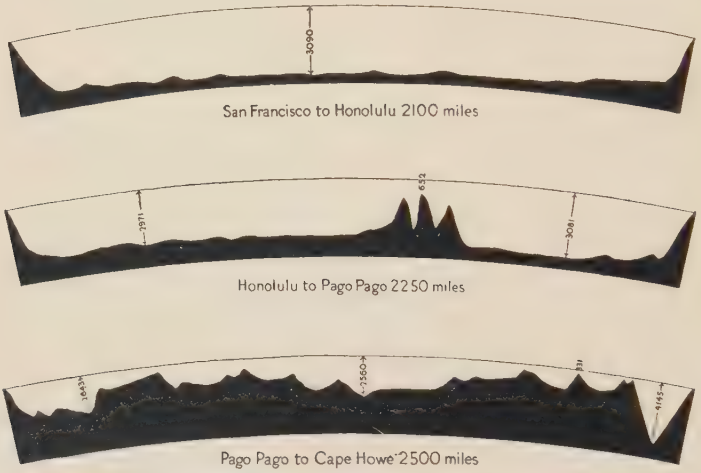

FIG. 2. PROFILES OF THE OCEAN FLOOR
Depths in fathoms, U.S.A. Hydrographic Survey

the Great Divide, running close along the east coast, and leaving only a very narrow coastal plain to drain to the Pacific. It then dips, partly submerged, under the hundred odd miles of Bass Strait to reappear in the Tasmanian Plateau; and then falls away under the sea to emerge far to the south in the Polar Continent.

This land-mass, usually named Antarctica, lies wholly within the Antarctic Circle, and is as yet comparatively unknown. Here there are summits rising to 15,000 feet above sea-level, some of them, e.g. Mount Erebus, being active

volcanoes. The heights run parallel with the shores of what is called Victoria Land, which possibly preserves under its mask of ice the characteristic coast-lines of the Pacific. The range is really the edge of a vast plateau rising to a level of 10,000 feet, from which the world's greatest glaciers slide slowly towards the coast.

The line of folding reappears above water and is continued through South and North America as the mighty walls of the Andes and Rockies which form the main axes of those two continents. The Andean system is a series of parallel Alpine folds running close to the west coast at a distance of 30–150 miles, and comprises the longest unbroken mountain system on the earth's surface. More than a dozen summits rise above 19,000 feet, and the peak of Aconcagua towers up 24,000 feet above sea-level. Amongst these peaks are the highest volcanic cones in existence. The crustal unrest of this region emphasizes the fact that the process of uplifting the Andes is still incomplete. From Aconcagua the system divides into two chains to enclose the high plateau draining to Lake Titicaca. Uniting again near the equator they again diverge, and the heights fall away rapidly towards Central America.

After an interruption by the older east-west arrangement of Central America the Divide again becomes well marked from Tehuantepec, and continues north as the Rocky Mountains, which are like the Andes cordillera but lower and wider. The Rocky system is not so high, is more broken by lower passes, and shows less contrast between eastern and western slopes. It is also set farther back from the coast, and behind the peninsula of California the height of land is a thousand miles from the sea. This mountain system is a double one in its general arrangement. It comprises two systems diverging to enclose the great Salt Lake basin which sinks in parts below sea-level. Behind California the highest peaks occur on the eastern wall, Mount Whitney in Sierra Nevada reaching nearly 15,000 feet. Converging again towards Alaska the

cordillera rises to even greater heights, of which Mount MacKinley (20,400 ft.) is the loftiest peak.

One-fourth of Asia, one-fifth of North America, one-tenth of Australia, and one-sixteenth of South America, or one-seventh of the world's land surface drains into the Pacific. The steepest part of the ocean floor is found in the north-west corner, where it rises to emerge as the Japanese and Kurile Islands. In front of this wall lies the deepest abyss in the earth's crust. It is part of an enormous depression called the Tuscarora Deep which swings round, horseshoe fashion, from near Hawaii across the front of Japan and the Kuriles almost to North America, at a depth everywhere of more than 4,000 fathoms. The curve of the depression where it touches the Japanese wall deepens to form the great gully known as the Japan Trench, which, like all the ocean trenches, is a centre of volcanic activity. Lower depths have been obtained elsewhere in the Pacific, but no other depression approaches the Tuscarora in extent. To the south the floor of the ocean is broken by a series of more or less parallel ridges with deeps lying between them. (Figs. 1 and 2.)

The greatest depth yet obtained was found by the survey ship *Nero* in the Marianne Trench, near the islands of that name. This was a sounding of 31,614 feet, or enough to submerge Mount Everest with 2,500 feet to spare.

The walls of the ocean basin rise steeply, and then flatten off towards the continents much like the shape of a soup-plate. The width of this flattened rim differs greatly according to the steepness of the bounding wall; but it is, in general, much wider on the Asiatic than on the American side. It includes the whole area of many shallow seas like the China Sea and the stretch between Northern Australia and New Guinea, and associates most of the great islands except Celebes and New Zealand with the nearest continent. Looked at in another way, the land bordering the coast-line is in most cases a low plain which rises gradually till it reaches 600 feet,

where a more abrupt slope to greater heights commences. This coastal plain is continued out under the sea, gradually dipping till it attains a depth of about 100 fathoms, when it drops, more or less abruptly, to the ocean floor. This flattened rim between the shore-line and the 100-fathoms line is known to oceanographers as the *continental shelf*. The action of the waves and tides ceases to be felt at 600 feet depth; and the immense deposits of silt brought down by the rivers, together with the deposits torn down by the action of the waves, are spread out and over this rim. It is on the continental shelf that the important changes in the ocean bed are occurring. Here flourish the sea-weeds and the vast array of sea life which they harbour; and so the shelf becomes the feeding-ground for most of the fish that are of use to man.

Deposits of different kinds are ever accumulating in the ocean. A shower of fine silt brought down by rivers, carried out by waves or winds, dispersed by volcanic eruptions or carried along by ocean currents, is always settling to the bottom. Along with this goes another shower of lime fragments made by the skeletons of the countless myriads of microscopic organisms that swarm in the ocean. The floor of the ocean is thus covered with a mantle of fine mud or *ooze* which fills up the hollows and rounds off the roughness of the ocean bed. These deposits fall, naturally, on and near the continental shelf for the most part, and form the earth-like or *terrigenous deposits* found usually within 250 miles of the shore. Farther out, in the deep water remote from land, are the *pelagic deposits*, mostly stiff red or brown clays containing little lime. These cover more than half the bed of the Pacific. From the length of time which pelagic deposits take to form, and from the teeth and bones of extinct species of sharks and other fish which are found at these depths, it is argued that these great depressions have never been above water.

The Pacific Basin has been in the past an area of great disturbance of the earth's crust. That it is still a region of

unrest is indicated by the rising and sinking of certain coasts and by the frequency of earthquakes. The reasons for this activity are still a matter of dispute among geologists; but, however the folding, subsidence, and elevation are caused, it is certain that lines of weakness are developed in the rocks of

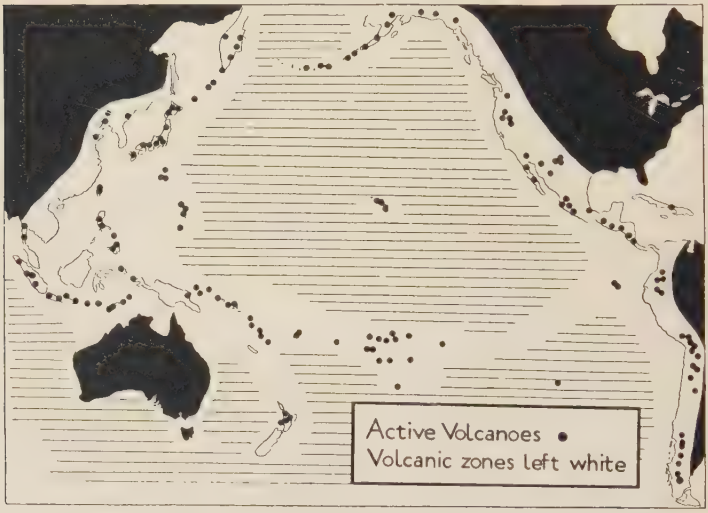

FIG. 3. VOLCANIC ZONES

the earth's crust. These lines of weakness act as safety-valves for subterranean energy, and volcanoes are the result. Of the 415 active and extinct volcanoes known in the world no less than 337 are found in and around the Pacific. Following this string of volcanoes around the ocean, we can start from the North Island of New Zealand and trace an almost unbroken line through the New Hebrides, New Guinea, the Philippines, Formosa, Japan, the Luchu Isles, and Kamchatka. Crossing by the Aleutian chain it continues right down the American cordillera to the Antarctic, where it ends in Mounts Erebus and Terror. A second line of weakness appears to

swing off through Manchuria, and to rejoin the main line again by way of the Malay Peninsula, Java, and the Sunda Islands. The condition of unrest which characterizes the Pacific coast is further demonstrated on the floor of the ocean in the very many groups of volcanic islands thrown up from

FIG. 4. EFFECTS OF THE GREAT EARTHQUAKE OF 1923, TOKYO

Acres of smouldering ruins, great crevasses, twisted rail tracks, broken telegraph lines, and smashed steel bridges tell of the force of the shocks

Hawaii to Kermadec, from Fiji to Galapagos, and in the continual appearance and disappearance of small islands.

A great contrast is presented by the coasts of the Pacific and of the Atlantic oceans. Both east and west of the Pacific the great mountain folds are arranged longitudinally with warps or bulges outward towards the centre of the ocean. The crust of the north-eastern part of the ocean floor is so thick and stable that the cooling and shrinking of the earth thrust up on the comparatively weak American edge the big series of folds

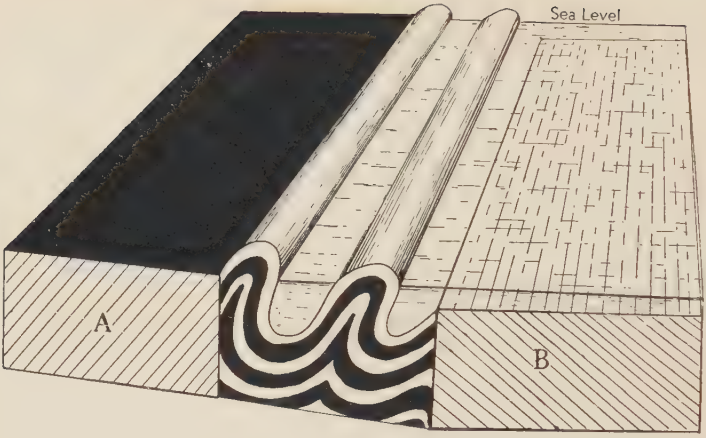

FIG. 5. MARGINAL FOLDING

Newer sediments folded by lateral pressure exerted by continental block (A) and oceanic block (B)

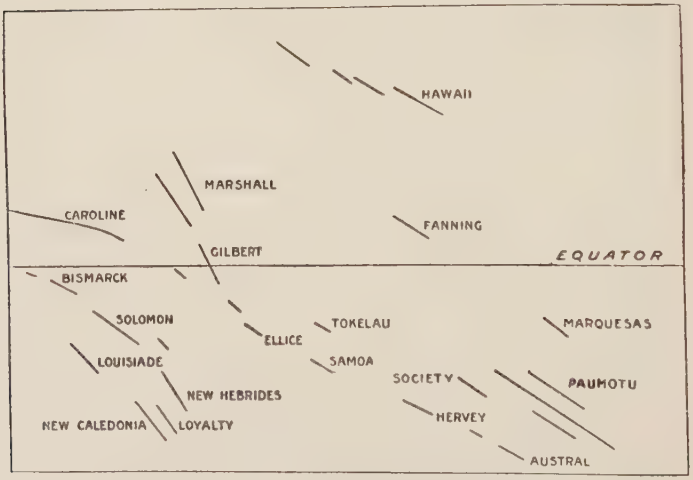

FIG. 6. TREND LINES IN THE PACIFIC

(After J. D. Dana)

that runs like a backbone through the two continents. The great land-mass of Asia, however, was so solid and heavy that the line of weakness developed more especially along the edge of the continental shelf, where an unusual sort of folding took place. These partially inundated folds have formed what Professor J. W. Gregory has called *festoons* of islands enclosing what are almost land-locked seas. While not so pronounced on the American side, a similar formation is seen in British Columbia and Chile. (Fig. 5.)

It will be worth while at this stage to emphasize this arc-like formation of the island chains, since this feature has been taken as the basis for dividing the islands of the Pacific into three main groups. Lying close in to Australia is the first great arc stretching from New Guinea to Fiji and including the Solomons, New Caledonia, and the New Hebrides. From the colour of the people who inhabited this group it was called *Melanesia*. After an interval of clear sea comes a longer arc bending from the Pellews through the Mariannes, Carolines, Marshall, and Gilbert Islands to finish to the north of Fiji. From the small size of the islands this chain was named *Micronesia*. Then, far out in mid-ocean, from Midway Island through the medley of the Marquesas, the Tuamotus, the Friendly, and Cook Islands is a great irregular group known from the number of its members as *Polynesia*. J. D. Dana has, however, detected trend lines which indicate parallel lines of folding from north-west to south-east. (Fig. 6.)

So much has been written about 'lost Pacific continents' that the relation of these festoons or arcs to the land-masses becomes of some importance. Geological research and ocean soundings prove that the islands fall into two great classes. There are first the *continental islands* formed by the tops of the partially submerged ridges and plateaux already mentioned; and, structurally, parts of an old parent continent. Others, formed by volcanic action and having no relation to the build of the older land-masses, are called *oceanic islands*.

FIG. 7. COASTS AND CORAL BUILDING

Continental islands rise from the continental shelf or from spurs of this shelf, e.g. New Guinea; and the continental shelf of the old continent may be taken to extend eastwards from Asia and Australia to a line connecting the Marshall, Gilbert, Samoa, Fiji, and Kermadec islands through the major group of New Zealand. Along this line occur the Kermadec, Tonga, and Higgard trenches, which probably mark the outward edge of a great former land-mass of which the continental islands are the remnants.

East of this and extending to the American wall is the true Pacific depression, from the floor of which rise the relics of volcanic upheavals which form the island-strewn expanse of Polynesia. These peaks and ridges rise with comparative steepness from great depths, and many fail to reach the surface. Of those which do emerge, some, like Hawaii, are so recent as to retain their original form of lava-cones and craters; while others, like Tahiti, have been much eroded and altered in appearance. The jagged outlines and steep peaks of these islands form much of the scenic charm of island landscapes in the Pacific. Many, again, have been so reduced that they have disappeared beneath the surface altogether; and this lowering has been accompanied by the building of coral-reefs which now stand at sea-level as the characteristic *atolls* of the South Seas, such as the Tuamotus and countless others, like 'garlands laid by the hand of nature on the tombs of departed islands'.

Coral islands and reefs are mainly formed of the stony skeleton of carbonate of lime built up by organisms known as coral polyps. They take many forms, but that of most importance in reef building unites into great branches. Although they are found in all the temperate seas they flourish best in salt, very warm, and very clear water. If the temperature is less than 70 degrees or if the depth is greater than 20 fathoms they are not active. They are therefore confined to the centre and west of tropical oceans, where the warm equatorial currents favour their growth. Coral

structures assume three distinct forms: (1) The *atoll*. This is a reef of a circular form with no land appearing in the centre. The water so enclosed is known as a lagoon and is usually

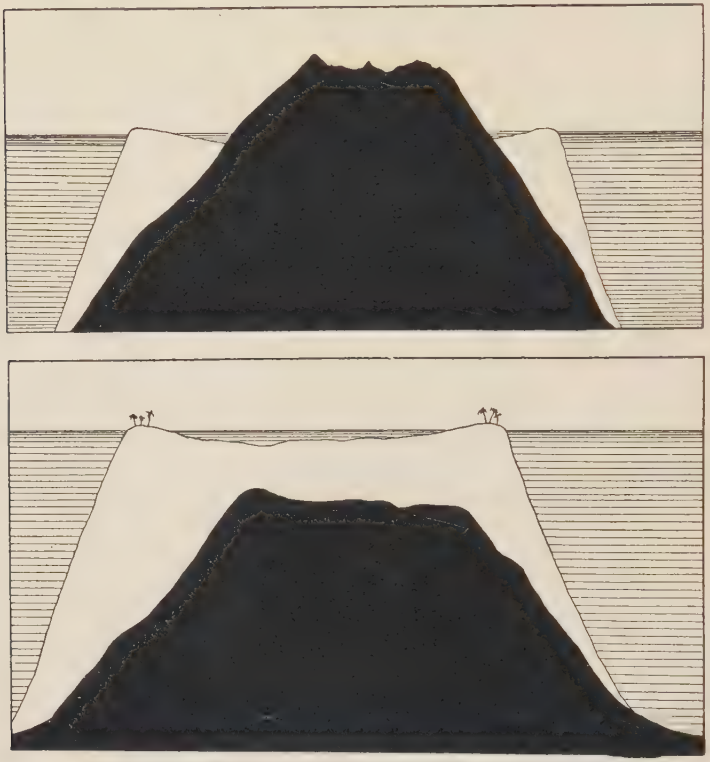

FIG. 8. AN ATOLL IN SECTION

Upper sketch shows volcanic cone and fringing reef; lower sketch shows cone broken down, and atoll form complete. (After Darwin)

shallow with further coral forming the bed. The polyp cannot build above sea-level, but blocks of coral are smashed off by the waves, thrown up on the reef and ground into coral sand. By the action of the sea this is gradually cemented into a compact mass of limestone, and may rise in time to a height

of 10 to 12 feet above sea-level. The coral polyps extend the reef by growing seawards, while those on the lagoon side die or at best remain inactive. The form is seldom quite circular and almost never complete; only portions of the reef show above water, thus they have the semblance of a chain of small islands. (2) The *fringing reef*, which is found near the shore in shallow water and grows seaward, leaving a muddy flat which gradually becomes dry land. (3) The *barrier reef*, which runs parallel to the coast and at some distance from it, with great depth, usually, on its seaward side. The Great Barrier Reef of north-east Australia, which runs for 1,200 miles along that coast like a huge natural breakwater, is the best example of many reefs of this kind.

Darwin formed the theory that atolls were formed by a fringing reef forming round a volcanic cone. Subsidence took place; and as the island slowly sank the corals built the reef always up to sea-level. Eventually, as the corals extended seaward to take advantage of the better conditions in the breakers, the reef would become a barrier reef. Finally, as subsidence still continued, the original mountain disappeared below the sea and left the reef, which continued its growth to form an atoll. Against this Sir John Murray, during the famous cruise of the *Challenger*, formed the opinion that the foundation for coral reefs was in every case supplied by submarine banks, which were raised by the deposit of ooze until they were within the range of corals. According to him, the corals raise a flat table of rock. When it reaches the surface it grows more rapidly on the seaward side, where food is more plentiful. The coral polyps on the inside then die, and a lagoon is gradually hollowed by the action of the waves, so that the atoll grows outward without widening, like a smoke-ring. The only flaw in this theory is that reefs are rare on rising coasts. However, it seems reasonable to suppose that atolls are, in fact, formed in both ways; although geologists largely divide themselves into opposing camps on this question.

The most significant features of the distribution of land on the west side of the Pacific are the prolongation of Asia eastward so as almost to meet Alaska at Bering Strait; the arrangement of the Japanese, Kurile, and Aleutian festoons; and the formation of the Malay Peninsula–Timor chain running parallel with Borneo, Celebes, Ceram, Papua, and the Melanesian festoon to form a double line of stepping-stones from Asia to the South Pacific. This projection of the great parent land-mass away out to mid-ocean has given the Pacific a marked Asiatic character. Geologically the rocks belong to the Asian system, whose structure and composition are retained by islands at great distances from the present continent. Again, the plants and animals are Asiatic rather than American or Australian in character. Above all, the human life is undoubtedly Asiatic in origin. The two extensions at the north-eastern and south-eastern corners of Asia offered easy routes for the migration of all forms of life. Man, with the help of frozen seas, could doubtless walk the whole way from Asia to South America; and the similarity of human types on both sides of the Pacific make it extremely likely that he did so. On the other hand, migration to the south-east must have involved some navigation; and thus we have the two great modes of migration—walking and sailing—determined by the arrangement of the land-masses. But the scattered oceanic islands were a different problem. They are not arranged on any such convenient plan; and their small size and wide spacing offer no easy highway for the wandering of plants and animals. Each group stands alone, geologically and biologically, like Coleridge's Ancient Mariner:

> 'Alone, alone, all, all alone,
> Alone on a wide, wide sea.'

Since our chief aim is to examine lands of the Pacific Basin as homes for man, something must be said concerning that other important factor of the environment, the soil. The

chemical composition of the soil, its heaviness or lightness, and its extent, form a factor that decides equally with climate which areas are possible for agriculture; and, in the long run, determines the distribution of the population and its density. For what man can do towards improving, reclaiming or irrigating soil is but a tiny part of what has already been done

FIG. 9. THE GREAT BARRIER REEF

Built up by coral polyps along the north-east coast of Australia. The surface of the Reef at low tide

for him by Nature. The great flood plains of the mighty rivers with their alluvial and wind-borne soils make possible the teeming valley populations of Asia. The Indo-Gangetic valley and the basins of the Yang-tse and Hoang-ho show on the grand scale the value of good soils to man. On the American side the fertile Sacramento and San Joaquin valleys afford further illustrations. Every variety of soil is to be found on the continents of the Pacific Basin and on the continental islands; but the oceanic islands are limited to two sorts. The

weathered remains of old lava flows yield the wonderfully fertile basalt soils of islands like Fiji and Java. Decomposed masses of coral from ages of reef building have formed the second type, i.e. the limestone beds of the atolls and of the island coasts.

Chapter II

CLIMATE IN THE PACIFIC BASIN

The big facts of the land and water distribution in the Pacific area have now been sketched. Climate is the second great factor which helps to decide how well or how poorly man can live in any particular region. Climate is, indeed, the chief factor in his economic life since it decides where certain plants and animals can live, and thus makes possible not merely the production of those commodities like silk and wool which he derives from them, but also the exchange which is the basis of trade. Climate not only decides what crops can be raised; whether, for example, rice or wheat or taro or rye shall be the main food supply; but also how they must be cultivated, as the contrast in the methods of growing wheat and rice well illustrates. Further, it has a very important effect on man's own comfort and energy, making him sluggish in the hot, humid weather and brisk and energetic in the cool. In this way his efficiency and his social and economic progress are to some extent determined.

We must not, however, lay too much stress upon these effects of climate, since, unlike the plants and animals which can adapt themselves only very slowly to changes in their surroundings, man has been able to move about and to select his homeland. Thus by his ability to roam he can escape the full tyranny of climate; but only under very great stress, such as a shortage of food continued for a long time, will those mass movements which we call migrations take place. In

whatever climate he is found man tends to 'stay put'. He has the greatest objection to changing his home and the particular climate, country, foods, and habits to which he has become accustomed. But slowly, silently, persistently, long residence in any region will affect the temperament of the inhabitants, their energy, and their ability to resist disease. For better or for worse, these changes are continuous and almost imperceptible. The hardy and industrious Chinese, the malaria-riddled Indian, the fun-loving Polynesian are all what they are largely because of the climate of their homelands.

In short it is not too much to say that climate, in addition to deciding what food man shall eat, what clothes he must wear, and what shelter he shall require, will also decide to some extent the level of his civilization. His standard of living helps to determine the character of his culture. Every study of Pacific peoples will furnish illustrations of these facts. The Maoris of New Zealand, migrating from their warmer home in mythical 'Hawaiki', had to adapt themselves to colder conditions which called for greater effort. In the struggle they developed great mental and physical powers, invented tools, built houses, and wove clothing suited to the new environment, developed an elaborate social system in which the laws of chivalry found full play, and raised their status among the peoples of the world to a high level. This was due more than anything to the energy and endurance of this great people, but there can be no doubt that climate supplied the motive power in their progress. The history of the Japanese, the achievements of the Eskimo in the Arctic regions, the adaptation of Europeans to the 'new' countries of the Pacific, even the struggle of the primitive Australian aboriginal against the arid conditions of his homeland, furnish other instances of the influence of climate on man.

The most important aspects of climate in this connexion can best be studied by considering separately the chief factors influencing weather, such as heat and cold, the all-important

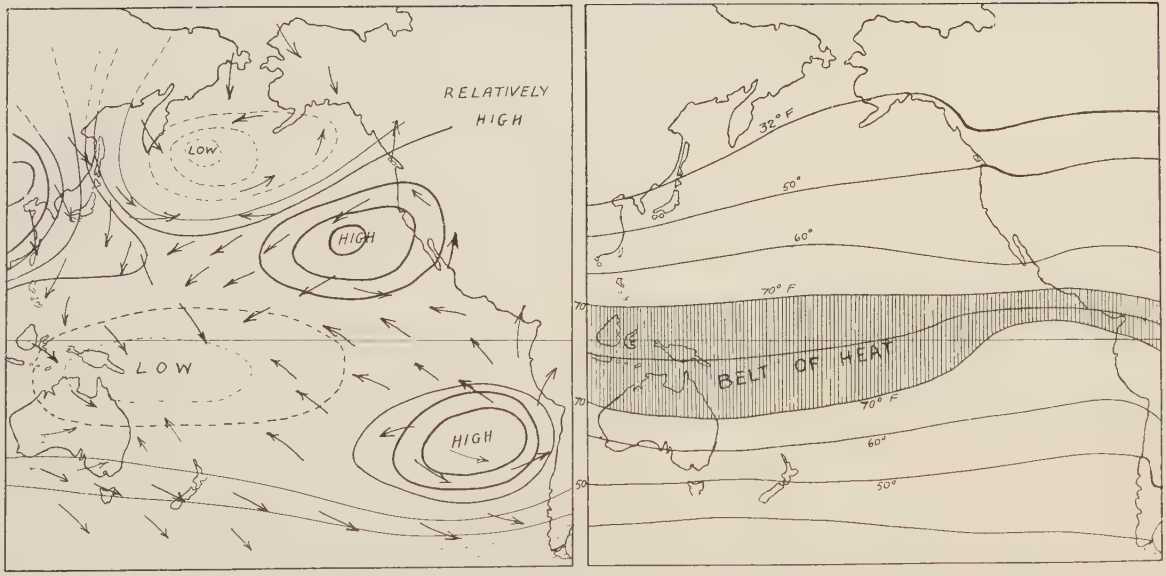

FIG. 10. TEMPERATURE, PRESSURE, AND PREVAILING WINDS, JANUARY

air pressure and circulation, the effects of altitude, and the consequent wetness or dryness of different regions. On these will depend the control which climate will exercise on human life and progress. Owing to the moderating influences of great masses of water, and the comparative evenness of surface within the basin itself, atmospheric conditions in the Pacific are remarkable for their close conformity with the world system. A description of this system will serve to make a study of the Pacific clearer.

Were the surface of the earth quite uniform, and the sun always shining overhead along the equator, the line of greatest heat and the equator would coincide. There would be constant low pressure in a zone along the line of greatest heat, and constant high pressure immediately north and south. Deflected only by the rotary movement of the earth, air would flow regularly from the constant high to the constant low pressure area. Actually the annual march of the sun north and south of the equator causes the line of greatest heat to move north and south too; but not so far nor so uniformly. The whole system of high and low pressures, Trades and Westerlies, swings with the line of greatest heat, the extent of the swing varying because of many local conditions such as the proportion of land and water and the general height of the land-masses. As a consequence, however, of the great uniformity of the ocean surface, climatic conditions in the south and east Pacific are the most regular in the world. The steadiness of the trade and westerly winds in this area is remarkable. West of the Pacific the swing of the wind system is exaggerated by the closeness of the two great land-masses of Asia and Australia with the line of greatest heat swinging between them. The North-east Trades are pulled farther south in January and the following months; and become the rain-bearing monsoons for northern Australia and dry offshore winds for Asia. Six months later the South-east Trades have been pulled far to the north by the great indraught over

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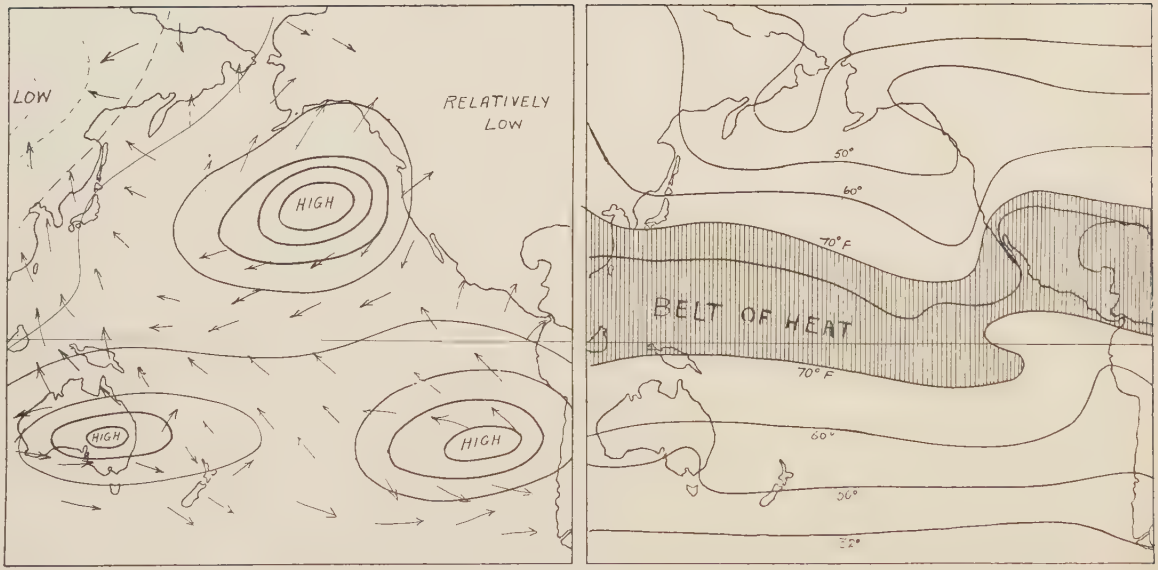

FIG. 11. TEMPERATURE, PRESSURE, AND PREVAILING WINDS, JULY

southern Asia, and constitute for that continent the southerly monsoons, which are dry off-shore winds for Australia.

The normal Trades are brisk breezes blowing steadily most of the time at 10 to 15 miles an hour. The blue sea and crisp white-capped waves are characteristic. They dispel the usual enervation of the regions in this latitude and account mainly for the pleasant climate of the so-called 'South Seas'. The Westerlies, on the other hand, are by no means so regular nor so moderate. They constitute a drift of the air-body to the east. In this current more or less violent eddies develop and are carried along as the rain-bearing 'lows' which are so characteristic of the climate of countries coming under the influence of the westerly drift. The Westerlies are steady and strong enough in the southern hemisphere to have earned the name of the 'brave west winds'; but the gales that accompany the 'lows' have given the latitude of greatest frequency the sinister title of the 'Roaring Forties'.

The most remarkable result of this 'one-way traffic' in wind circulation is the one-sided rainfall effect where the Trades or Westerlies cross land high enough to cause heavy discharge of their moisture. Thus most of the islands of the Pacific, e.g. Java, Hawaii, Tasmania, have a wet windward side and a drier leeward side. On a bigger scale continents are likewise affected. The coast of Queensland, for example, receives ample rainfall from the trade-winds which leave the corresponding coast of Western Australia as absorbers rather than depositors of moisture.

In the North Pacific conditions are not nearly so regular; and, in particular, there are great differences in climate for places in the same latitude. The eastern margins of continents in the northern hemisphere have, in general, more extreme climates than the western margins. Only hardy cereals such as barley and rye can be cultivated in certain protected valleys in Saghalien, while in British Columbia in the same latitude all the temperate grains and fruits are grown as commercial

crops. The main Japanese islands are in the same latitude as California but have a far more rigorous climate. Coasts and islands, too, have generally a much smaller range of temperature than continental interiors. The remarkably uniform temperatures of Melanesia, Micronesia, and Polynesia are a commonplace of meteorology. Mean annual temperature here varies little above or below 70° Fahrenheit, and there is no noticeable difference between the temperatures of the warmest and coldest months. The range from midday to midnight temperature is greater than the range from summer to winter. The following table will show typical differences in the range of temperature for maritime and interior situations.

TEMPERATURES FOR JANUARY AND JULY

COASTAL			INLAND		
Place	*Jan.*	*July*	*Place*	*Jan.*	*July*
Sydney	71°	53°	Bourke	84°	50°
Shanghai	37°	79°	Pekin	27°	81°
Seattle	39°	63°	Chicago	25°	79°
Honolulu	65°	85°	Hankow	37°	88°

These figures suggest the difficulty involved in any attempt to classify climate. Modern meteorology has gone a long way from the old and rather primitive divisions of climate into tropical, temperate, and polar; and it is now realized that there are very different types of tropical climate, that the so-called temperate climates are the most inclement in the world, and that the Polar regions are not so white as they are painted. Classifying climates on the basis of rainfall, temperature, and humidity, the following general types of climate are now recognized: continental, oceanic, coastal, monsoon, desert, and plateau.

Oceanic climate has been treated already, so that we need only say here that it is marked by moderate temperatures, high humidity, heavy rainfall, and much wind. There is a relatively low variation between summer and winter, and between day and night temperature, in fact so low that

many island climates lack the stimulus that weather changes provide.

Continental climate is almost the opposite of oceanic in every respect. Instead of a range of less than 10° between the mean of the hottest and the coldest months we get a range three and four times as great between day and night and between summer and winter. Many interiors range from a minimum somewhere below zero to a maximum above one hundred degrees in the shade, with lighter rainfall especially on lowlands.

Coastal climates, as the name implies, are a transition type between continental and oceanic, and the farther from the seaboard the less becomes the oceanic effect. Mountain ranges along the coast, in fact, often confine the coastal type to a mere ribbon of coastal plain. Wind direction and the direction of the *grain* of the country therefore determine how far inland the marine influence is felt. Where the prevailing winds are mostly on-shore, as in trade-wind and westerly wind belts, the climate is markedly oceanic; but where the prevailing winds are off-shore, as in north-west Australia, the arid inland conditions are taken right to the coast-line.

Monsoon climates are found in the regions where the winds are periodic in character, an effect that has already been analysed for the typical monsoon belt comprising south-eastern Asia and northern Australia, with the intermediate islands.

Desert climate varies, of course, for hot and cold deserts; but in general it is marked by little rainfall, strong winds, and great difference between day and night temperature, owing to high radiation after sundown especially in the case of the arid trade-wind deserts.

Plateau or *mountain* climate is the effect of altitude rather than latitude; but the direction of the main ranges in relation to the direction of the prevailing winds brings about wide variations even in this type. Cool temperatures, a big daily

range, and low humidity are the chief characteristics; and these may vary greatly as between the wet and the dry sides of highlands.

With regard to temperature Koeppen distinguished five belts which provide a very useful classification for economic

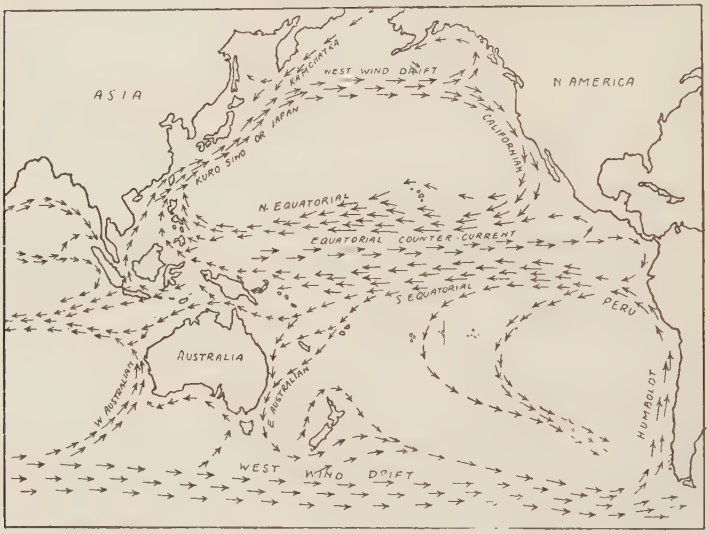

FIG. 12. OCEAN CURRENTS

purposes. The basis of this division relates to the number of months in the year which are important in man's chief occupations, e.g. the length of the growing period for trees and grains which is the result first and foremost of temperature changes during the year. The part of the year which is most important to the farmer, the pastoralist, and the forester, and the occupations that are possible for the remaining months, are, of course, determined by climate. Regarding the question in this way Koeppen takes certain limits of temperature to distinguish important zones. Bodily discomfort begins above 68°, so that becomes an important upper limit for white

workers. Trees cannot grow where the average temperature is not at least 50° for one month, so that forests disappear in certain regions. Again, wheat and most deciduous trees require at least eight months with temperature above 50° on the average, so that we get another important economic zone. These facts supply the foundation for his classification of five temperature belts, as follows:

1. *Tropical*: hot all the year round with an average temperature of more than 68°. This includes a zone stretching from about 20° north latitude to about 16° south latitude.
2. *Sub-tropical*: one to four months above 68° with the remainder of the year above 50° mean temperature.
3. *Temperate*: from four to twelve months averaging between 50° and 68°.
4. *Cold*: one to four months temperate with the remainder of the year averaging below 50°.
5. *Polar*: average annual temperature below 50°.

It should be remembered, however, that human comfort depends on humidity as much as on temperature, and that the bare record of heat is not sufficient on which to base a classification which would indicate *habitability*. Still, in so far as Koeppen's five belts indicate the conditions that are favourable or otherwise for vegetation growth, the classification is a useful index upon which the natural regions of the world can be broadly determined.

One other condition associated with climate with which so far we have not dealt concerns the effect on the water circulation. This is due to the same influences that affect the circulation of the air; and it follows just as regular a plan. The surface currents are largely decided by the wind system, and the general effect may be likened to the spinning of a wheel. To start the wheel spinning one pushes the rim in the direction of spin; and the spin could be helped by pushing one way on the top side and in the opposite direction on the bottom side. A similar circulation is given to the waters of the Pacific

by the Trades and the Westerlies, which stir the surface water in opposite directions. Thus, in the South Pacific, the Trades blowing off-shore from Peru push the cool waters here towards the equator. This stream sweeps past the Galapagos Islands as the commencement of the South Equatorial Current. Pushed to the west by the steady Trades and becoming warmer all the time, it sends off branches among the many island groups and passes on down the Australian coast as the East Australian Current. It then sets westward under the influence of the westerly winds until it unites the smaller branches in a drift towards South America which steadily becomes cooler. This drift splits on the wedge of Cape Horn, one current passing up the west coast as the cold Humboldt Current to join the South Equatorial Current once again.

Off the coast of California the north-east Trades set up a similar current which sweeps across as the North Equatorial, and turns round by way of Japan as the Kuro Siwo or Japan Current to be pushed towards the North American coast by the Westerlies. The behaviour of the currents near the East Indies is so important that they must be studied a little more closely. Off the coast of New Guinea the South Equatorial divides and streams round and through the Malay Archipelago to join the North Equatorial to the north of the Philippines. During the period of the south-west monsoon a tributary current sets in from the Indian Ocean, and increases the pressure so much that a broad, warm, stream with a surface temperature of 85° carries its moderating influences right along the Chinese and Japanese coasts. This is to the Pacific what the Gulf Stream is to the Atlantic. The warm water of the two equatorial currents is piled up around and between the East Indies, and one way of escape is along the belt of the Doldrums between the two Trade-wind currents. This drift flows straight back towards Panama as the Equatorial Counter Current. Mention must be made also of the cold Polar Current which streams down through Bering

Strait and along the coast of Kamchatka to Saghalien, taking the cold Arctic influences as far south as northern Japan.

It has been calculated that the sea carries nearly half of the heat absorbed in the tropics away into higher latitudes to act as warming influence along the eastern margins of continents, while the colder currents drawn down from the Polar regions extend the cold conditions towards the equator. Thus the Pacific acts as a great heat- and cold-regulator for all the shores which are washed by its currents. Its vast uninterrupted surface permits the very regular development of the air and water systems; and tends to prevent climatic extremes.

Chapter III

MAN IN THE PACIFIC

The ancient Greeks saw their homeland surrounded by Oceanus, the great river which was the source of all streams and waters. The Father of All dwelling far out on the edge of the world presided over this stream, and over the lives and destinies of all that lived in and around it. In such fancy they expressed their dependence upon the sea, and acknowledged its great influence on their lives and habits. From their narrow valleys and rocky hill-sides they faced outwards over the waters which promised the more ample livelihood that their sterile homeland denied. The ebb and flow of the tides and the ceaseless unrest of the waters stirred the curiosity of 'the land-born barbarians about the unseen destination of these marching waters'. The islands set in the near distance beckoned the first voyagers, the warm blue seas invited to adventure, and so the Greek by the force of circumstance almost became at once trader, sailor, and colonist.

Wherever man has come down from his hills to the sea it has moulded his life and outlook in much the same way, has

given much the same direction to his activities, has set him the same problems of navigation and prompted the same responses of boat and oar and sail in their solution. His voyages, as they became longer and surer, brought him to new and different lands where novel conditions called forth new powers and abilities. Mastery of the sea is thus a very late chapter in the story of man's conquest of his world. For centuries he must have paused baffled at the edge of the ocean, but the long and difficult struggle gave him, in the end, command of those vast expanses of water which cover three-fourths of the earth.

With that achievement the world really becomes one, and the long epic of man's oversea wanderings began. Phoenician, Greek, Roman, Viking, and Arab on their voyages of trade, discovery, or piracy helped to establish those connexions between the coast-dwellers which have become the great network of sailing routes in our day. The changes from the primitive raft to the mighty liner mark the painful steps by which man achieved his freedom of the seas, and, incidentally, the unity of his world. The ocean thus became the great common possession of all peoples. The emphasis that has been placed by all trading nations on the 'freedom of the seas', and the enormous expense undertaken by modern powers to guard their trade routes, are sufficient proof of the value of right-of-way on the high seas.

Outside Europe itself and the adjacent areas the greatest skill in navigation was attained by the island folk west of the Pacific. Long before the date of the Norman Conquest the Malay in his catamaran had achieved long voyages that make the Odyssey seem but an incident. Here in the vast island-studded stretches of Oceania the Greek epic was repeated on a greater scale, and a race of boatmen was developed who were as much at home on their warm tropic seas as on their reef-circled islands. Inhabiting a mere half-million square miles of island homeland they pushed their dominion out over

twenty-five million square miles of desolate waters. Kupé, greatest of Polynesian navigators, selecting his little band of Argonauts, feeling his way before the Trades, charting the islands of New Zealand, and by means of that latitude observation registered in the sacred calabash returning safely to 'Hawaiki' to give his sailing directions to the Great Fleet

FIG. 13. MALAY FISHING BOATS, BORNEO

Populating the Pacific became possible when Asia produced its own Vikings

of Maori 'Pilgrim Fathers', yields nothing in skill or endurance to Henry the Navigator, Columbus, or Drake.

Migration, in truth, makes up much of the history of Pacific peoples. The palm beach made a fairly safe frontier from every enemy but the hurricane, and in these secluded areas were planted the little Polynesian colonies. But the dynamic centre of this great ripple of humanity spreading over the Pacific is to be found away back towards Asia, and for reasons many of which we can only surmise. The Indonesian Archipelago possessed all the elements for building a race

of seamen. Here the curious mixture of river and sea bred the amphibious Malays who emphasize their love of the water by their pile dwellings. Here each settlement became another Venice; and many, like that great sea-kept city, became centres for traffic and commerce to which in after-years the European trader found his way. Along the coasts and on the rivers of Asia we find the teeming human life spilling out on to the waters, because these offer food to the fisher, roads to the trader, and highways to the adventurer. The millions of water-folk in China and Japan, and the Eskimo in the far north learning his latest lessons in the conquest of the Arctic seaboard, furnish other instances of man's triumph over the sea.

'Fisheries have ever been the nurseries of the seamen'; and in tempting man to dare its dangers the sea has given him experience far more valuable than any wealth it has yielded. As the sea became a highway, so islands became points of settlement and, later, jumping-off places for still further migrations, or busy ports of call along well-known trade routes. But consider the difficulties involved in such travel. East from the Philippines or the New Hebrides our Polynesian navigator would find landing-places separated by distances varying from 100 to 1,000 miles. Yet these distances were traversed, and voyages such as that from Hawaii to Samoa were undertaken over unknown seas and in open canoes—achievements beside which our great feats by sea, land, and air seem much less wonderful.

Nor were their troubles over when the voyage was safely accomplished and the new land found. The farther the Polynesian pioneers pushed out from the continents the smaller grew the islands, and the poorer the animal and plant life. Food of a sort was obtainable; but the only plentiful article of diet was fish. Animal life they could not import, but the rice from Asia and the coco-nut, taro, bread-fruit, and yams from Malaysia were introduced and cultivated. Even

flints for weapons and cutting tools were wanting, and substitutes had to be found in bones and sharks' teeth. Where, as in the case of the Maoris, the everlasting summer of the sub-tropics was exchanged for the colder, wetter climate of New Zealand wholly new arts had to be invented. Spinning and weaving were developed for warmer clothing, stone weapons were manufactured, sturdier houses built and different plants cultivated. Indeed the whole Pacific area supplies examples of the manner in which man has adapted himself to a new homeland, or modified the conditions of the new land to make life possible.

But the migration and wonderful developments of Pacific peoples are but one side of the story. Too often the environment has proved too strong. The enervating climate, the confined space, and the easy life on Pacific islands have in many cases arrested the development of these wonderful seafarers. Civilizations rose and fell in the Pacific as elsewhere. Scattered through this island world huge monuments and abandoned fields are all that remain of great peoples who had advanced very far in the arts of civilization. And with the coming of white men to these regions the decadence of many Pacific islanders seems to have been hastened. Isolation can bring its dangers as well as its security. Depopulation is a distressing reality in most of the islands despite the fact that labour for tropical agriculture is so urgently required; and Asiatics have had to be imported in large numbers. The future development of the islands will demand much labour, but here are the facts about declining populations. In 1870 it was estimated that Polynesia contained 690,000 native people. In 1930 there were about 200,000, but 145,000 Asiatics and 37,000 whites had come in. Melanesia was computed to have three million natives, but recently numbered scarcely one million. Micronesia declined from 273,000 to less than 90,000. In fifty years two-thirds of the native population have disappeared.

On the contrary some of the East Indies, the Philippines, and Japan show great increases of people, so great indeed that some islands now have all the population that their resources will permit. Some island peoples are already spilling over into neighbouring lands, and in particular the vigorous migration from Japan seems to promise that the expansion of England in the nineteenth century will find a parallel in the expansion of Japan in the twentieth. Japanese ideas and ideals are affecting the Pacific from Korea to California and from Alaska to the Argentine.

One other aspect of the population of Pacific regions should be noticed here. Many lands face more ways than one, and their people demonstrate this fact. The wild Malayan on the mountainous east of Formosa, for example, is as different as possible from the Chinese farmer of the western plains. The Philippines hold very different peoples in the north and the south. Again, many islands such as Borneo and Yezo show primitive aboriginal races in the inaccessible interior, and later comers of a higher type round the coasts. These differences are a natural result of successive waves of migration dashing against the same islands. The later wave, as it were, drives the earlier one before it. The unequal density of people all round the Pacific is another aspect of population that should not be overlooked. Densely peopled islands like Java exist side by side with almost empty islands, China with 430 millions of people overlooks Australia with but $6\frac{1}{2}$ millions, and so on. These crowded and empty lands, side by side, form very difficult problems that call for the utmost patience, forbearance, and understanding between the inhabitants of the great Pacific Basin.

Chapter IV

NATURAL REGIONS OF THE PACIFIC

1. THE HOT LANDS

NOTE. During the reading of this chapter reference to the regional map inside back cover will prove helpful.

THE position, relief, climate, and natural vegetation of large portions of the earth's surface are so much alike that we can distinguish groups or classes on the basis of these likenesses. Further, we can detect broad resemblances in man's occupations in such regions. These groups of similar areas are called by geographers *major natural regions*; and we shall proceed in our study of the Pacific Basin by treating these natural regions rather than the political divisions we call countries. In this way our study will become more systematic and, we hope, more pleasant.

Now the factors which make up environment such as build, climate, soils, and water distribution vary so enormously that the resemblances just mentioned lie deep rather than on the surface. Furthermore, the appearance and habits of peoples living in the same natural region have often not the faintest common resemblance. The differences, however, will on closer study serve to emphasize the likenesses, and will help to show the effect of other than geographical factors. Only by a study of this effect can man's own efforts to modify his homeland be understood. The racial stock from which the people spring, the sort of government they have developed, the past history of the region, its accessibility, and the possibility of transport form the background upon which must be shown the picture of life in different lands.

We shall now consider the different types of major natural region as they are illustrated by the lands in and around the Pacific Basin, dividing them broadly into the following groups

(which may be compared with Koeppen's classification quoted on p. 27): 1. Hot Lands. 2. Warm Temperate Lands. 3. Cool Temperate Lands. 4. Cold Lands. Each of these groups, thus classified according to temperature, can be subdivided into typical regions. In the hot lands around the Pacific we can distinguish six main types which are called the Equatorial, Mid-Pacific, Monsoon, Savannah, Trade-wind Desert, and Plateau types. A careful study of the statistics of temperature and rainfall will reveal the basis of such a division more clearly than many words.

1. CLIMATIC DATA FOR HOT LANDS

Natural Region.	*Place.*	*Height above Sea (feet).*	*Temperature. Degrees F.*		*Mean Annual Rainfall (inches).*	*Season of Rain.*
			Jan.	*July.*		
1 A Equatorial	Batavia	23	78	78	71	All seasons
	Singapore	10	78	82	93	
	Manila	25	78	84	76	
	Gilbert Is.	S.L.	80	78	100	
1 B Mid-Pacific	Honolulu	S.L.	68	74	30	All seasons
	Suva (Fiji)	S.L.	80	72	90	
1 C Monsoon	Shanghai	20	37	80	44	Mainly in summer
	Port Darwin	70	82	75	62	
	Ichang	350	39	78	40	
1 D	Quixeramobim (Brazil)	700	83	78	23	Mainly in summer
	Daly Waters (Australia)	700	85	67	28	
1 E Trade-wind Desert	Iquique (Chile)	30	71	61	2	Scanty at all seasons
	Onslow (W. Aust.)	S.L.	84	64	7	
1 F	Quito	9,350	54	55	42	All seasons

1 A. *Equatorial*

The regions belonging to this group are the Malay Peninsula, the East Indies, Melanesia, and coastal Ecuador. These lands lie mainly in the belt of the Doldrums, where the constant up-draught causes condensation at a certain height. It will be seen, also, that winds for these lands are carriers of moisture. Temperature is uniformly high, and the combination of heat and wetness produces the characteristic equatorial forest. From the coastal swamps to the heights inland, however, there is a great variety of climate and consequently of vegetation. The lowlands are those areas of damp, steamy heat so favourable to malarial fever, and so difficult for white settlement.

The reason for the heavy rainfall around the 'line of greatest heat' should be clearly understood. Evaporation is high on account of the great heat, for the warmer the air the more vapour it will hold. This warm, comparatively light air is pushed upwards by the colder, heavier air pressing in from south and north as the Trades. When this saturated air has risen to a sufficient height to meet cooler conditions condensation takes place and rain results. The air now flows off in a northerly or southerly direction as a cool, dry current which settles back to the surface near the Tropics. Here it becomes warmed again; tends to absorb rather than to deposit moisture; and flows off along the surface as the Trades, or in a southerly direction as the Westerlies. This regular system of air circulation and daily rainfall over equatorial lands must be kept firmly in mind as the key to much that follows.

1 B. *Mid-Pacific*

This group comprises most of what is called Polynesia. Typical areas are Hawaii, Tahiti, Marquesas, Cook Islands, and Fiji. The climate of this Mid-Pacific type is determined by the insular situation at great distances from any continent,

in the first place; and by the action of the trade-winds, in the second. This is the true oceanic climate. Mean monthly temperature varies little from season to season, and rainfall depends markedly upon elevation. Most islands have a wet and a dry side, and this condition controls agriculture to a great extent. Some islands are sufficiently high to trap a constant rainfall; but many, the atolls in particular, are too low-lying to receive sufficient rainfall to support human life. The rainfall map of Oahu (Fig. 96), one of the islands of Hawaii, will provide a good sample of the climatic conditions on the larger islands.

1 C. *The Monsoon Countries*

Lying on either side of the true equatorial type (1 A) are the regions in the tropical monsoon group, viz. India, Burma, Siam, Cochin-China, Annam, Southern China, Northern Australia, coastal Queensland, and Central America. The swing of the wind and rainfall systems with the sun causes a modification of the trade-wind system whereby the SE. Trades are drawn north to Asia in July, and the NE. Trades are drawn south to Australia in January. This could be regarded as an explanation of the seasonal off-shore and on-shore monsoons. It is really, however, more than a mere modification. About January the sun is overhead in the northern parts of the Australian continent, and a 'furnace' effect or low-pressure area is created, while, over the cold central highlands of Asia, a high-pressure area is generated. The general flow from high to low pressure gives the dry off-shore winds for Asia and the wet on-shore winds for Australia. Six months later the positions are reversed. Thus these regions have in general a hot-wet season and a cool-dry season with undecided 'change-of-season' periods. The on-shore winds flow over great stretches of water with conditions of high evaporation; and where they meet high land such as the

western Ghats, the highlands of Assam, or the Atherton tableland in Queensland, very heavy rainfall results. There is, however, great unevenness of rainfall since the leeward slopes receive much less than the windward slopes. There is usually enough rainfall to maintain a moist subsoil at all seasons, so that extensive forests exist which, however, are not so dense as the true tropical forests. On account of the dry season the bamboo becomes the typical growth, but palms and hardwoods such as teak are also characteristic. Rice, sugar, and cotton are universally cultivated in these areas. The very successful experiments in transplanting crops like rice from one monsoon region to another illustrate the importance of regional study.

The monsoon lands of Asia are remarkable for their dense populations, a result of their tremendous productivity. The teeming millions found in south-eastern Asia would be impossible if Nature did not yield her bounty most abundantly in response to man's efforts.

1 D. *The Savannah Regions*

The most extensive region of this type occurs around the equatorial forests of the Amazon and Congo Basins. The only true region of this type of any extent in the Pacific occurs in the interior of northern Australia. Normally there are, on each side of the equatorial forest, regions which have alternate summer rainfall and winter drought as the wind system swings north and south with the sun. They are, in fact, very like the monsoon lands except that they lie inland. The winds are not so strong and regular, however, nor is the rainfall so heavy. Still, heat and rain, cool and drought are the regular seasonal characters.

As we leave the equator, rainfall gets lighter by imperceptible degrees until a zone is reached where there is not sufficient moisture retained in the subsoil at all seasons to support forests. Therefore vegetation shades off from dense

tropical jungle, through lighter jungle and bush, to open grassland, with trees only along the water-courses or in favourable patches. This mixed grass and bush country goes by the type name of *savannah*, after the local name for the area north of the Amazon valley. The environment determines the occupation of the people, and cattle-rearing is universal in all these grasslands. Sheep do not thrive here on account of the humid conditions of the wet season, and the harsher nature of the vegetation.

1 E. *Trade-wind Deserts*

As distance from the equator increases, the tapering rainfall effect is continued through the savannah lands until finally an area is reached where little rain falls, and that only at most irregular intervals. These regions of great unreliability of rainfall are situated near the tropics, and in the zones where the trade-winds originate as dry currents rapidly absorbing surface moisture. On the eastern sides of continents these NE. and SE. winds bring rainfall, but on the west they are off-shore drying winds. Thus the Great Australian Desert, the Atacama Desert of Chile and Peru, and the Bad Lands of Arizona are members of this group.

There is no other natural region so uniform in its characteristics as that of the trade-wind deserts. Varying greatly in extent on account of local conditions such as the arrangement of the mountains or the extent of the continental mass, they are everywhere sterile and almost devoid of plant life. Man makes a home in these regions only under the attraction of profit, as in the case of the nitrate industry of South America or the goldfields of Western Australia. Along their margins some tribes such as the nomadic Aruntas of Central Australia or the Hopi Indians of New Mexico find a precarious existence. Civilized men have been able to found settlements at spots favoured by the presence of artesian water. The saying

that 'Europe stops at the Sahara' merely emphasizes the fact that deserts have always been most effective barriers to trade and migration. The Central Australian Desert cuts off northern Australia from the south in the same fashion.

1 F. *Equatorial Plateau*

This is a special type of tropical region the climate of which is truly 'temperate'. On plateaux such as those of Ecuador and Colombia that occur near the equator, heat is tempered by altitude. Weather conditions vary very little from month to month, but economically the region is of little importance. Agriculture is limited on account of the difficulty of ripening crops, and the inhabitants are unable to provide even for their own needs in this respect. The pasturing of sheep and cattle is therefore of prime importance, and becomes the mainstay of the region.

Chapter V

NATURAL REGIONS OF THE PACIFIC

2. THE WARM TEMPERATE LANDS

The temperate zones are found, roughly, between the tropics and parallels 50° N. and S.; but, on account of the width of the zone and the great variety of surface, the term 'temperate' becomes somewhat a misnomer. There are within this belt very considerable differences in the amount of heat received during the year, and a wide range of annual rainfall. As in the trade-wind belt, east coasts of continents contrast with west coasts, and the climate of interior lowlands with that of interior highlands. It becomes convenient, therefore, to study this great zone in two divisions, viz. warm temperate and cool temperate lands.

2 A. *West Coast or Mediterranean*

This forms one of the most clearly marked of the natural regions. Placed, as they are, on the poleward side of the Trade-wind Deserts, such lands come alternately under the influence

2. CLIMATIC DATA FOR WARM TEMPERATE LANDS

Region.	*Name.*	*Height above S.L. (feet).*	*Mean Temp. Deg. F. Jan.*	*Mean Temp. Deg. F. July.*	*Mean Annual Rainfall (inches).*	*Season of Rainfall.*
2 A West Coast or Mediterranean	Perth (W. Aust.)	47	76	55	33	Winter rains; Summer droughts
	Melbourne	115	67·5	48·5	25	
	Auckland	50	66·5	51·7	44	
	Valparaiso	135	63	53	50	
	San Francisco	60	50	58	24	
2 B East Coast of China	Sydney (N.S.W.)	150	72	52	48	All seasons, but most rain in summer
	Hankow	121	40	87	48	
2 C Interior Lowland or Darling Basin	Bourke (N.S.W.)	450	84	51	17	Most rain in summer
	San Antonio (Texas)	1,000	82	51	25	
2 D Interior Highland or Mongolia	Urga	3,800	15	63	8	Most rain in winter
	Salt Lake City	4,350	29	76	16	

of high and low pressure belts as these swing north and south with the sun. They are really a transition region lying between the Trades and the Westerlies, and the weather is markedly seasonal. The swing of the wind systems brings them under the control of the Westerlies in winter when they receive their main rainfall. As the Westerlies swing away from

the equator again these lands come under the domination of the high-pressure areas where the Trades rise, and this brings a season of summer drought. Such conditions characterize the lands round the Mediterranean, and hence the name.

The influence of climate upon vegetation is most clearly marked in these regions, since the plant life must be adapted to withstand the summer drought with its relatively high evaporation. Evergreen trees with deep-striking roots such as the eucalypts or the 'live-oaks' of California are typical, and similar trees from the Mediterranean countries have been introduced with great success.

Among these are the olives, the cork-oak, and the citrus fruits which are cultivated in all these lands. The grape and such soft-fruit trees as the peach, apricot, and plum, which need sustained warmth to bring them to perfection, find in these regions their best climate; and, where irrigation makes possible regular supplies of water during the growing and ripening period, they respond with prolific crops.

This is also the natural climate for wheat cultivation, and other plants that thrive under these conditions are maize, tobacco, and cotton. The main industries of the regions of this type that occur around the Pacific are therefore concerned with fruit-growing and preserving, wine-making, oil-pressing, fruit-drying and canning. These are characteristic of southern Australia, the North Island of New Zealand, southern Peru and northern Chile, and California. Here again the value of regional studies for indicating the crops best suited to certain regions has been amply demonstrated by the experiments in interchanging the plants of these different countries. The introduction of all the fruits mentioned into Australia, and the planting of Australian species in California and Italy, are instances of this movement.

It is worthy of note that in these areas the European settler has found conditions which suit him and his domestic animals

admirably, and it is therefore not surprising that these lands are all lands of white colonization.

2 B. *The East Coast or China Type*

Members of this group within or near the Pacific Basin are China and coastal New South Wales. The climate resembles very much the monsoon type, except that temperatures are not so high. New South Wales is affected in summer by the south-east Trade circulation, and in winter by the cyclonic 'lows' which carry rain from the south and bring snow to the highlands. China, especially away from the coast, is more continental in type, with colder winters and hotter summers. There is no really dry season, but the greater part of the rain usually falls in summer. This produces abundant vegetation, and a wide rangé of cultivation becomes possible, including such typical plants as tea, maize, and rice.

2 C. *The Darling Basin Type*

Interior lands of the warm temperate belt are found also in North and South America on the 'high plains' eastward of the Andes and Rockies. Inland situation, characteristic climatic extremes as between summer maximum and winter minimum temperatures, and deficient rainfall mark these areas. Owing to the low-pressure generated over continents in the hot season, inflowing winds will tend to be moist, while the winter high-pressure results in dry outflowing winds. Therefore most of the rain which falls in these areas is concentrated in the summer. In general it is only sufficient to maintain grass or poor, scrubby vegetation. The fact is that these regions are 'rain-shadow' areas, since the presence of mountain barriers in the path of inflowing winds accounts for the scanty fall. The vegetation is that of the 'steppe' lands which are the typical sheep-raising areas of the world. Under the influence of dry-farming methods the better-watered margins

are being sown with wheat, as in the Mallee district of Victoria and in similar areas of the Argentine. In most of them irrigation cannot do more than provide water for farm-stock.

2 D. *Interior Highland or Mongolia Type*

Conditions resemble those of the regions of the areas treated under 2 C; but, owing to elevation, the climate tends to be much more extreme, with snowy winters and scorching summers. Arid tracts are common, and the grassland provides pasturage for sheep and cattle. The high mountains which make snow water available for irrigation, for example in Utah, suggest possibilities for Mongolian development.

Chapter VI

NATURAL REGIONS OF THE PACIFIC

3. THE COOL AND COLD LANDS

This group occurs on the poleward side of Mediterranean regions, and comes well within the influence of the westerly winds. It assumes most importance from the fact that the greater part of Europe—the home of the white races—belongs to this group. Very great differences in the extent and arrangement of the cool temperate lands arise from the position of the mountain systems in relation to the Westerlies. The European arrangement, highlands running for the most part east and west, allows the moderating influence of the Westerlies to penetrate far inland, whereas in the similar American areas the north and south arrangement of the highlands is no protection against the cold Arctic conditions. A study of the 32° isotherm for the winter months will show how fundamentally these differences in the disposition of the grain of the country affect climatic character.

In general the same sub-classes may be distinguished as in the case of the warm temperate lands, i. e. west and east coast, interior lowland and interior highland.

3. CLIMATIC DATA FOR COOL TEMPERATE LANDS

Region.	*Name.*	*Height above S.L. (feet).*	*Mean Temp. Deg. F. Jan.*	*Mean Temp. Deg. F. July.*	*Mean Annual Rainfall (inches).*	*Season of Rainfall.*
3 A West Coast or Vancouver Type	Victoria (B.C.)	S.L.	38	60	38	All seasons, but mainly in winter
	Valdivia (Chile)	50	61	45	106	
	Hobart, Tas.	165	62	46	24	
	Hokitika (N.Z.)	S.L.	60	45	115	
3 B East Coast or Siberian Type	Vladivostok	60	7	67	15	All seasons, but mainly in summer
	Hakodate	20	27	70	44	
3 C Interior Lowland. Prairie Type	Harbin	520	2	72	19	Mainly in summer
	Winnipeg	760	7	66	22	
3 D Interior Highland. Rockies Type	Calgary	3,400	12	60	15	Mainly in summer
	Kamloops (B.C.)	1,200	25	69	11	
3 E Tibet Type	Lhasa	11,900	27	65	15	Mainly in summer
	La Paz (Andes)	12,100	52	45	21	

3 A. *West Coast Regions*

The climate and position of lands of this type in the Pacific are remarkably similar. Coastal ranges set athwart the track of the Westerlies characterize each member of the group,

viz. Tasmania, the South Island of New Zealand, British Columbia, and southern Chile. These winds in each case encounter very high land immediately after traversing the widest ocean expanses in the world. The clear-cut distinction, therefore, between the rainfall of windward and leeward sides of the intercepting highlands is only to be expected. Other important effects are the remarkably equable climate, and the even distribution of the rainfall throughout the year. The parallel arrangement of the coastal mountains gives rise to great variations in rainfall within a few miles.

These regions present great likenesses, also, in the matter of vegetation; and the occurrence of the typical forests of softwoods give them a peculiar economic importance. The Douglas fir of the Oregon and British Columbian coastal areas is a striking product of the rainfall conditions, as are the beech forests of the west coast of Tasmania and New Zealand. The natural forests in suitable areas have been largely replaced by introduced trees such as the apple and pear, although in the warmer and more sheltered valleys soft fruits of the apricot type are also grown extensively. The hop plant also finds a congenial climate in these regions. It is the climate peculiarly suited to dairy-farming, which tends to become the main pastoral occupation.

Typical alpine scenery, with glaciers and snow peaks, is characteristic of these areas, while fiords and drowned valleys of the ria type are coast features. These fiord coasts, again, are the results of extensive subsidence, and the conjunction of the numerous inlets and the continental shelf provide the best living conditions for many varieties of fish. This is the physical basis of great fishing industries of which the best instance is furnished by the salmon industry of British Columbia and Alaska.

3 B. *East Coast or Maritime Siberia Type*

The members of this group in or near the Pacific are maritime Siberia and Patagonia, and although they are in about the same latitude they offer a great contrast to the lands of the previous group. The Pacific coast of Asia north of 50 degrees has a more extreme and much less genial climate than the corresponding coast on the American side. The average rainfall and the distribution throughout the year differ considerably on east and west coasts, and the reason is to be found in the general low pressure which exists off the coast of Kamchatka right through the year. The flow of air is predominantly off-shore on eastern coasts in this latitude, and this is the fact that supplies the chief reason for the lighter rainfall.

Winter conditions, in particular, afford a great contrast. The Asiatic coast north of Korea is ice-bound for several months, but the harbours of British Columbia are clear all the year round. This difference is mainly accounted for by the influence of the ocean currents of the north Pacific. Because of the influence of the Japan Current the Westerlies are warm winds and carry this warmth as far as the coasts of British Columbia and Alaska. In addition the cold Kurile Current flows in along the Asiatic coast from the north and helps materially to intensify the contrast.

The vegetation of the region under discussion is mainly pine forest of great extent although, as yet, almost untouched in Siberia. These forests represent, in fact, the world's great reserve of softwoods. At present tribes of hunters and trappers eke out an indifferent existence in them. The sole representative of the type in the southern hemisphere is the region of Patagonia and southern Argentine, but the tapering of South America in this case, and the protecting influence of the Andes, make conditions less extreme than in the corresponding area of the north Pacific. Instead of forest the

characteristic vegetation here is grassland or steppe, but the climate is too cold for the development of agriculture.

3 C. *The Interior Lowland or Manchuria Type*

Regions belonging to this class are of comparatively small extent in the Pacific Basin. They are found at their best in the prairie regions of the interior of the great northern landmasses. Manchuria is, in effect, a lowland basin enclosed by mountain walls. The climate is so extreme as to be bitterly cold in winter, contrasted with short, hot, continental summers. Rainfall, moreover, diminishes as the coast is left behind, and occurs mainly in summer. The fall is not heavy enough for tree growth, hence the characteristic grasslands which in Canada have become the famous wheat-growing areas. Manchuria is far behind Canada in this respect, but Chinese farmers are now settling in these areas in large numbers, and the region is bound to become very productive in the future. Tribes of nomads still claim extensive tracts.

3 D. *Interior Highlands or Rocky Mountain Type*

The alpine mass of the Rocky Mountain system is the chief representative of this group. The heavy coniferous forest of the lower western slopes gives place to the typical bare, snow-clad, rocky peaks at greater heights. The eastern side, generally, is drier and less forested. This variation occurs in Siberia also, but the contrast is rather between northern and southern slopes. The latter gradually approach in character the bare, cold desert of inner Mongolia.

With great variation in surface and aspect, these regions also present great differences in their ability to sustain plant and animal life. The Rockies, in particular, have great possibilities of future economic development. The fur-bearing animals of the region have always maintained a scanty population by hunting and trapping, but the immense

timber, water-power, and mineral resources now offer infinitely more to an industrial world. In the valleys and on the foot-hills agriculture and pasture are possible on an extending scale.

3 E. *Interior Plateau or Tibet Type*

The only two regions of this type occur in the Pacific Basin, viz. Tibet and Bolivia; and although each has a climate that may be classed as temperate, there are considerable differences to be noticed. Both are plateau regions with an average height above sea-level of more than ten thousand feet, and both are associated with mountain systems that are among the highest in the world. But the fact that Bolivia is so much nearer the equator and nearer the ocean than Tibet would lead us to expect a milder climate in one case than in the other, and this is actually so. The Tibetan tableland, situated in the centre of the world's greatest land-mass, has long and very severe winters and a warm to hot summer; whilst Bolivia has, in general, a moderately cool and very even climate. The conditions do not favour agriculture; and, consequently, except in the warmer and more sheltered valleys, pastoral industries are the main support of the people of both regions. Both, too, are associated with animals peculiarly adapted to the conditions of their homeland, viz. the yak of Tibet and the llama of Bolivia. Conditions are more generally favourable to human life in Bolivia than in Tibet.

Mineral wealth abounds in both, but the difficulties of labour and transport are a retarding influence. The difficulties that were faced by the early Spanish settlers in working the silver mines of the Bolivian plateau persist there to the present day. The region is very difficult of access in the first place, and Europeans find that the great altitude induces lung troubles of various kinds. The natives are of a primitive type, and do not offer much assistance in the work of development.

4. COLD LANDS

These inhospitable regions are nevertheless not so cold and so barren that man cannot manage to exist here and there, and as there are certain resources which tempt even civilized man to live in them they deserve brief mention. Perhaps, too, it is only fair to say that they make up in interest what they lack in economic importance. Three types are to be

4. CLIMATIC DATA FOR COLD LANDS

Region.	*Name.*	*Height above S.L. (feet).*	*Temp. Deg. F. Jan.*	*Temp. Deg. F. July.*	*Annual Rainfall (inches).*	*Season of Rainfall.*
4 A Northern Forests	Dawson City	1,200	−24	60	15	In summer
	Yakutsk	330	−19	60	30	
4 B Tundra	Point Barrow	S.L.	−19	38	8	In summer
	Upernavik	S.L.	−8	42	9	
4 C	Ice Cap		A region of intense cold whose chief point of interest, climatically, is the strong, sustained gales known as blizzards.			

distinguished, only one of which, the polar ice-cap, is to be found in the southern hemisphere. Stretching across Asia and North America to the north of the cool lands is a great belt of pine-forest. Nearer the pole the forest fades out owing to the intense cold, and gives place to the open, barren lands called *tundra*. Around the poles are the regions of perpetual ice and snow which, even though inaccurately, we call the polar ice-caps. The climatic data for these areas cannot convey any idea of the intense cold, or of the miraculous change that the short, nightless summer works in these Arctic lands. The contrast between the frozen sea around

the North Pole and the ice-bound continent around the South Pole is also to be noted.

4 A. *The Northern Forests*

Forests are impossible where the summer temperature falls below 50 degrees, even where the rainfall is sufficient. The dividing line, therefore, between tundra and forest is determined by the summer temperature. These northern forests are vast expanses of pine and spruce woods as yet almost untouched by the hand of man. The structure of the trees with their needle-like leaves is admirably adapted to the long winter with its intense cold and heavy snowfall. The only tree which sheds its leaves and manages to resist the rigorous conditions is the birch. In Alaska and the Mackenzie Basin the forest is found 300 miles within the Arctic Circle, but in eastern Canada it does not reach within 500 miles of this circle, affording yet another illustration of the differing conditions to be found on the western and eastern margins of continents. These forests form the world's greatest fur-hunting grounds, and are inhabited only on their fringes by such hunters and trappers as the Ostyaks and Samoyedes.

Backed by modern science the white settler is beginning to invade even this area; and on the southern edges of the forest, especially in Canada, is steadily pushing his agricultural holdings farther and farther north. The efforts of the agricultural scientist in these areas are directed to the breeding of varieties of wheat which will ripen in the short, intense summers with their long days. A period approaching ninety days for the growing season is necessary for successful farming, even on the southern margins. Rye, barley, and oats are better suited as crops for this region.

4 B. *The Tundra*

This is the zone of dwarfed and sparse vegetation into which the forest fades away on the north, and which in its turn gives

place to the unbroken fields of snow and ice around the pole. Here all agriculture is impossible, and only in the summer is nomadic man active in these regions by reason of the movements of animals. The life and habits of man in these areas will be treated later in the book.

BIBLIOGRAPHY TO PART I

Joly, John. *The Surface-History of the Earth*, 1925. (Clarendon Press.)

Fowler, G. N., and Allen, E. J. *Science of the Sea*, 1928. (Clarendon Press.)

Brown, J. Macmillan. *The Riddle of the Pacific*, 1924. (Unwin.)

Johnstone, James. *A Study of the Oceans*, 1926. (Arnold.)

Kendrew, W. G. *The Climates of the Continents*, 1927. (Clarendon Press.)

Howarth, O. J. R. *Climate and Geography*, 1927. (Clarendon Press.)

Huntington, Ellsworth. *Civilisation and Climate*, 1924. (Yale Univ. Press.)

Semple, E. T. *Influences of Geographic Environment*, 1911. (Constable.)

Haddon, A. C. *The Races of Men and their Distribution*, 1924. (Cambridge Univ. Press.)

Taylor, Griffith. *Environment and Race*, 1927. (Clarendon Press.)

Brown, J. Macmillan. *Peoples and Problems of the Pacific*. (T. Fisher Unwin.)

Roberts, Stephen H. *Population Problems of the Pacific*, 1927. (Routledge.)

Herbertson, A. J., and Herbertson, F. D. *Senior Geography* with Physiographical Introduction. (Clarendon Press.)

Hardy, M. E. *The Geography of Plants*, 1920. (Clarendon Press.)

Newbigin, M. I. *Animal Geography*, 1913. (Clarendon Press.)

Newbigin, M. I. *Modern Geography*, 1925. (Home University Library.)
Commercial Geography, 1926. (Home University Library.)

Cunningham, J. C. *Products of the Empire*, 1921. (Clarendon Press.)

Taylor, Griffith. *Antarctica*, pp. 518–38 in the Oxford Survey of the British Empire. (Clarendon Press.)

PART II

MALAYSIA AND THE EAST INDIES

Chapter VII

MALAYSIA

The main mountain fold of this region extends through the Malay Peninsula and ends in the small islands of Banka and Billiton. Another fold runs parallel to the peninsula through Sumatra, and swings through Java, the Sunda Islands and Timor to northern Australia. Still others may be traced due east through Borneo, Celebes, New Guinea, and Melanesia, and through Borneo, the Philippines and Formosa back to Asia. It is in fact a region of extensive subsidence, where peaks, ridges, and plateaux are all that escaped the drowning of the old continental margin. A deep trench passes between Borneo and Celebes; and, on the evidence afforded by the different plant and animal life on either side of this deep, the naturalist Wallace concluded that this marked the ancient division between Asia and the old Pacific continent. The evidence of such complete separation, however, is in many ways not so strong as Wallace thought. The secondary volcanic chain, which runs from the north of Malay Peninsula through Sumatra, Java, Sunda Islands, Moluccas, and Philippines, marks a line of weakness in the earth's crust, and may indicate where crumpling took place during the great crustal changes in the past.

This is the region of almost continuous high temperature with rain at all seasons. The Europeans who live in these lands are wont to declare that 'it rains every day, but there is never a wet day', by which they mean that condensation of the warm, saturated, uprising air is always taking place, giving the characteristic tropical rains and thunderstorms.

Sunshine and rain alternate, often several times in the same day; and thus the hot moist conditions that produce the abundant plant growth of the tropical forests are maintained. Heaviest rainfall occurs, generally speaking, near the equator. Farther north and south the seasonal summer distribution becomes more marked, and the true monsoon effect appears.

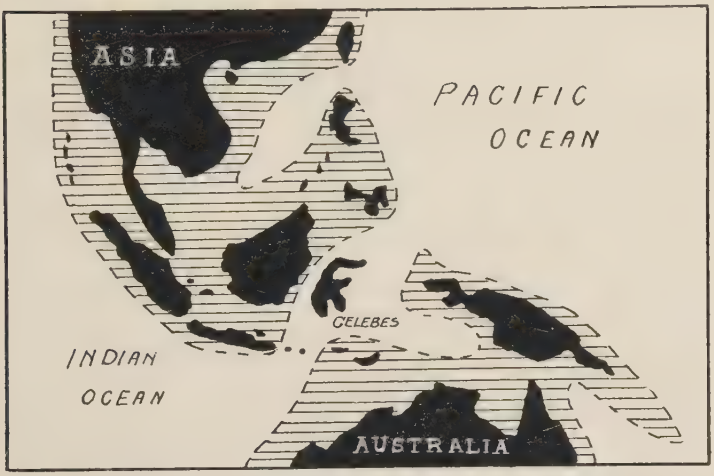

FIG. 14. THE CONTINENTAL SHELF (SHADED) BETWEEN ASIA AND AUSTRALIA

Melanesia is on the edge of this region; and may be regarded as a transition type between the double-monsoon areas and the trade-wind, mid-Pacific group.

Something more must be said of the inhabitants of the archipelago. Owing to the stepping-stone arrangement of the islands and the restless, adventurous disposition of certain coast-dwellers, the East Indies present a great mixture and blend of racial types. But the ease of access to the coastal regions is in marked contrast to the difficulty of penetrating the mountain interiors; and, as a consequence, the coastal and the inland peoples are in most cases of different races.

The dark-skinned woolly- or frizzy-haired people who inhabit the forest interiors represent the early arrivals, while the lighter and very different immigrants of a later date are to be found in the Malay or Hindu communities of a much higher type living on the coasts and lowlands. This is, of course, a very general statement that does not nearly account for the great diversity of human types found in Malaysia, a diversity that is due to the fact already mentioned, that the islands represent the piers of an ancient land-bridge which once connected, or almost connected, Asia and Australia.

The early waves of migration from Asia washed over a far more extensive terrain than now exists in the south-east, in the shape of a broad hook with the point to the north of the Philippines. The tropical forests were then far more extensive than they are now, and it can be easily realized from any map of the area how little crossing of water was involved. Those earliest adventurers were, quite possibly, tree-dwellers; and were short and small in build. The remnants of these people are the pygmies with the 'kinky' peppercorn hair still sheltered in the remote interior forests. Some of these, such as the Semang and Sakis of the Malay Peninsula, are still largely tree-dwellers. Still other waves of Stone-Age man moved on to people New Guinea, Australia, and Tasmania. These were ground-dwelling hunters; and, although the Australian aboriginals were more advanced than the Tasmanians, possessing a large assortment of bone and flint weapons and the curious boomerang, neither type had arrived at the bow and arrow stage, nor had either any notion of agriculture or the storing of food.

Another great wave of migrants which washed in and out among the islands of the archipelago in much later times is represented by the Malays who are of Mongolian type, and most thickly settled in Malaya and Sumatra. They are more active and intelligent than most of the earlier types over whom they have obtained a supremacy. Still later, as the result of

FIG. 15. A VILLAGE IN MALAYA

Note (*a*) the well-constructed pile dwellings which are a protection against damp and wild animals, and the ladder which is drawn up at nights; (*b*) the use made of bamboo in the raft and of bamboo and palm leaf in the houses; (*c*) the heavy clouds; and (*d*) the clothing of the natives

the trading visits of Hindu merchants, extensive colonization took place in Java and Sumatra by Indian peoples. From this blend arise the Javanese, who are by contrast with the Malays[1] an orderly and industrious people supplying the great bulk of the labour now required on the plantations. Add to this great patchwork pattern a proportion of Chinese, who mainly appear in the rôle of merchants and miners, but have here and there become wealthy plantation owners and landlords employing quite large numbers of their countrymen. Then weave in a fringe of Arab traders who have been represented in the archipelago for seven or eight centuries, and some conception will be had of the very mixed populations which have been feeling the impact of the white man for more than three centuries. The story of that impact, the trading control established in different times and places by Portuguese, Dutch, and English, and the highly adventurous and romantic efforts of men like Sir James Brooke and Sir Stamford Raffles do not belong to this book.

The whole region, however, takes on a new importance in modern times because of the increasing need of the great industrial countries for the products of tropical countries. As Dr. Knowles said, an age that runs on rubber tyres and walks on rubber heels, that prefers tea, coffee, and cocoa to wine, that needs the tin, and copra, and quinine, and a thousand other highly important commodities that will grow only in equatorial countries, is placing a greater and ever greater importance on tropical possessions. The old haphazard methods of producing these things will not do in this day of large-scale production when the supplies of all of them must be regular and in ever-increasing volume. Therefore the white man has been forced to go into the tropical lands and organize the agriculture, the mining, the railway and harbour

[1] The Malays are, in general, restless, almost sea-nomads, not fond of farming, nor indeed of any form of work, which is willingly left to the women.

building; and the people just described are those whose help he must seek in accomplishing those ends.

One other aspect of life in the archipelago deserves brief mention, and that is the tangle of national interests that compete in this corner of the Pacific. Here the traders of many lands from the Arab to the Dutch have marked out their own special spheres of enterprise; the Chinese merchant engaged in catering for the needs of the native peoples comes into contact with the energetic Australians from the south, who have come to the islands in search of adventure or wealth or both, in the way of trade, or tin-mining, or developing the plantations. Japanese steamship agents, Frenchmen interested in Annam, and officials and commercial travellers from many another country witness to the interest of the outer world in these undeveloped territories.

Chapter VIII

BRITISH MALAYA AND NORTH BORNEO

The Malay Peninsula must be pictured as a mountain mass that is gouged and scooped in every direction by the vigorous rivers fed by the tropical rains. A central spinal-column of granite rises, forest-covered, to summits 8,000 feet above the sea, and divides the peninsula into a narrow coastal plain up to 30 miles wide on the west, fringed by mangroves and dismal mud-flats, and an eastern portion in which low, rolling hills end in a sandy coast-line. Towards the south the mountains flatten out into the plains of Johore. Ages of erosion have spilt on the lowlands the alluvial soil that is the basis of agriculture in this area. The tropical forest, sometimes almost impenetrable jungle, is everywhere; and it is important to realize its density since it presents Man the Pioneer with his most difficult settlement problems. Climate, plant growth, and animal life are all hostile to his advance;

FIG. 16. MALAYSIA. Highlands shown black

and penetration, even by the most vigorous peoples, is at best a slow process. Indeed it is not until the white man appears with his infinitely better equipment that the forest gives way at all perceptibly before man's onset.

Good descriptions of the equatorial forest are plentiful, and the following passage will help to form a picture of jungle conditions:

'In these immense forests of the tropical rain regions the decay of vegetable matter during countless ages has enriched the soil to a depth of many feet, and from it has sprung a marvellous tangle of vegetation. Huge trees, shrubs, bushes, underwood, thorns and trailing vines all struggle to reach the light. Trees with lateral branches are rarely seen, but instead they shoot up, straight and smooth, for a hundred feet before branching out into a large, cabbage-like top. Ferns, mosses, orchids, and other parasitic plants cover the trees from top to bottom. Immense rope-like vines, passing from tree to tree, up and down, some of them 600 feet long, bind the jungle in one big tangle. Orchid plants abound on every side, but to the observer on the ground their blossoms, like other flowers, are conspicuous by their absence. If only the jungle could be examined from an aeroplane its beauty and wonderful colours would be seen in their full glory because the tops of the trees are often ablaze with blossoms.' (C. Wells.)

These forests are very extensive and rich in tree types, and more than 4,000 species in the archipelago have already been named. Comparatively few, however, are of any economic importance. The great bulk of the forest is composed of one family, the trees of which support, as it were, the roof of the forest on trunks rising for 100 feet without a branch. Smaller and still smaller species which manage to thrive in the shade, compose the several lower stories, and below all these riots the undergrowth. Most of the trees are hardwoods, and many yield products of great importance such as resin and gutta-percha. The rotan, usually spelt rattan, or climbing palm is one which yields a product that is

familiar in most places. No extensive bamboo forests are found because there is no pronounced dry season. The most common palm—i. e. the coco-nut—is not a native of the tropical forest, and is encountered mainly on the coast and in the cultivated areas.

Within this vast forest home lives a great range of animal life. Such typical mammals as the elephant, rhinoceros, and tapir are numerous. It is the haunt of tigers and bears, and many varieties of deer, especially the dainty mouse-deer, a little animal hardly larger than a hare. Monkey tribes from the *siamang* or great ape to the long-tailed *lotung* and the domesticated *brok*, used by the natives for gathering coco-nuts, roam everywhere through the trees. Countless species of birds, too varied for description, inhabit the tree-tops; while below, reptiles from the great crocodiles of the swamps to the king-cobra and the giant lizards form the least attractive group of forest denizens.

The portion of the jungle that has been cleared for cultivation by man is still insignificant. Only in the alluvial valleys and on the coastal plain is agriculture general as yet. There rice, tapioca, and the coco-nut are the main crops of the natives, who, however, are unable to produce all the foodstuffs they require. Under the direction of Europeans, Malaya became the scene of a great experiment in tropical agriculture. Coffee and sugar were first tried as plantation crops, but the outcome was not very successful. Then came the wonderful success which attended the transplanting of the rubber tree—*Hevea brasiliensis*—an experiment from which the great plantations producing more than half the world's output of rubber have grown.[1] More than two and a half million acres of rubber plantations now form the basis

[1] The rubber tree requires deep, well-drained soil, warm climate, rainfall well distributed throughout the year, and protection from wind. Hilly situations have proved to be the best. About 95 per cent. of the world's rubber comes from British possessions, while 70 per cent. is imported by the United States.

FIG. 17. 'ELEPHANTS A'PILIN' TEAK, IN THE SLUDGY, SQUDGY CREEK'

Typical of the timber industry in Burma and Siam

FIG. 18. STRAIGHTENING RATTAN CANES, BRITISH MALAYA

Notice the bundles of cane, ready for the market, being carried away by the men in the background

ST. MARYLEBONE
PUBL... BRARY

FIG. 19. RUBBER PLANTATION IN MALAYA

Note (*a*) the careful numbering of each tree to record the yield of sap; (*b*) the method of 'tapping'; (*c*) the type of plantation labour; and (*d*) the 'contour' planting in the background

of Malaya's main industry, on which all the resources of modern science have been brought to bear. The modern rubber plantation furnishes an object-lesson in specialized work, from the carefully selected native labourers with their up-to-date houses and medical services to the army of scientific workers charged with the duty of safeguarding the flow of sap in perhaps half a million trees. Soil experts, agricultural chemists, botanists, entomologists, statisticians, and accountants all find a place in the wonderful business of rubber production, upon which the prosperity of Malaya is mainly based.

The peninsula is famous also for the amount of tin produced. Under the alluvial soils of the lowlands, but on top of the granite bed-rock, are hidden those immense deposits of almost pure tin which are the source of more than half the world's supply of this commodity also.[1] The chief methods of recovery present a contrast between the primitive sluicing of the Chinese fossickers, and the costly dredging-equipment of the big mining companies. Tin, however, is not by any means the only mineral wealth of the area, for coal, iron, gold, and tungsten are other minerals mined in Malaya.

Politically the peninsula is divided into (i) British Malaya, confined mainly to the southern half, of which Singapore has displaced Malacca as the main gateway; (ii) the Federated Malay States, which are governed by native rulers under British protection, and of which Kuala Lumpur is the chief town and port; (iii) the independent native states. The city of *Singapore* (500,000) owes most of its importance to its situation at the cross-roads between India and China, and between Australia and Japan. The city lies on a flat island about twenty-five miles long and fifteen miles wide, separated from the mainland by a narrow strait. It has become a great

[1] These alluvial deposits are known as 'stream tin'. Chinese control 60 per cent. of the tin mines in the Federated Malay States. The dredging companies recover about 20 per cent. of the entire output.

mart for the East Indies, a busy coaling station, and one of the biggest oil-fuel distributing centres. Its status as a port depends on its situation as a point of transhipment, i.e. the products of the archipelago are collected there, while the exports to the islands are there loaded from the large steamers into the smaller craft trading among the islands. Smelting of

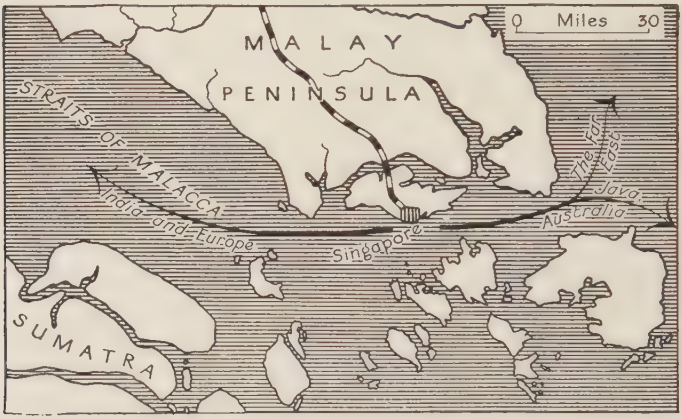

FIG. 20. THE POSITION OF SINGAPORE

tin is an important industry. The food and clothing for the three and a half millions of people on the peninsula, and for millions more represented by the outports, pass through its warehouses, which are largely in Chinese hands.[1] Ranking high among the ports of the world it has a splendid harbour, great docks, and extensive coaling and loading facilities. Into this heavily fortified basin 30,000 vessels a year bring manufactured goods in exchange for the rubber, tin, hides, copra, and the innumerable other products of the region. The old port, *Malacca* (180,000), has been displaced by the newer

[1] The census of 1921 showed the following racial distribution in British Malaya: Malays, 28 per cent.; Chinese, 55 per cent.; Hindus, 11 per cent. Of the labourers on the rubber plantations 70 per cent. are Tamil coolies from British India.

commercial centres, and now plays a minor part in the economic life of the peninsula. *Penang* (325,000), the busy northerly outlet of British Malaya, derives its importance from the rich soil and favourable climate of the district. Lying on the main route between east and west it has developed a large oversea trade in which rubber predominates.

FIG. 21. TIN DREDGING IN MALAYA

Notice (*a*) the low-lying jungle country; (*b*) the typical heavy clouds; and (*c*) the heap of 'tailings' left as the dredge moves forward

Tin, spices, rice, and sugar are other main lines of commerce here. *Kuala Lumpur* (80,000) is well situated in the heart of a tin and rubber producing area. Copper is another important mineral mined in the vicinity, while coffee, rice, and copra are important trade staples. It is the head-quarters of government and railway administration for the Federated Malay States, and possesses a population of more than a million people. *Ipoh* in the centre of the tin-mining area is, however, the metropolis of the States, and has shown remarkable development in the last decade.

It will be convenient before passing on to a study of the

Dutch East Indies to deal with the other British possessions except New Guinea. On the north side of the massive island of Borneo is a group of states with relations to the British Crown somewhat similar to those of the Malay Peninsula. These comprise (i) British North Borneo, a territory under the direction of a chartered company; (ii) Brunei, a protected native state; (iii) the small island of Labuan, and (iv) Sarawak.

British influence in this region was strengthened after 1840, when steps had to be taken to suppress Malay piracy, which had become a serious menace to trade. The organization of Sarawak was successfully accomplished by an able and adventurous Englishman named James Brooke, who afterwards became the acknowledged *rajah* or ruler of the state. His descendants still govern as independent administrators. Politically the term British Malaya includes not only the federated and non-federated states of Malaya proper, but also the dependencies and outlying islands of North Borneo.

Physically North Borneo is an extremely mountainous region. The mountain mass lies towards the north of the island, and Sarawak lies in the fertile coastal region between the mountains and the sea. British North Borneo occupies a similar but more broken region at the extreme north of the island. With the exception of the more open uplands, the greater part of the island is a vast jungle watered by a network of rivers. Much of the region has never been penetrated by white men. The rivers provide the only highways into the interior, and very little trade is carried on away from the river settlements. Climate and products greatly resemble those of the Malay Peninsula.

Chapter IX

THE DUTCH EAST INDIES

1. *Historical and Physical*

Historically these islands are very closely connected with Australia. The Portuguese reached the archipelago in the sixteenth century, and were closely followed by the Dutch, who in the next hundred years had established many trading ports in the islands. By 1640 Batavia had become a great centre of trade, and so important was the traffic to Holland that exploration was pushed on around all the coasts of Australia except the east. The most remarkable of these voyages was that of Abel Janzoon Tasman, who set out with two ships in 1642 and sailed right round the continent via Mauritius, Tasmania, and New Zealand without, however, sighting the eastern coast. It was a most notable feat of navigation and exploration, and exemplifies the spirit of the early Dutch traders and settlers who laid the foundations of a wonderful colonial empire in the east, the importance of which to a modern world they could not possibly have foreseen.

It is safe to say that even in these days comparatively few people realize the extent and economic importance of these great tropical islands to the north of Australia. A journey between the most easterly point of Sumatra and the most westerly point of Dutch New Guinea would involve a journey of over 3,000 miles, or about the distance by rail from Brisbane to Perth, or from Liverpool to New York. In extent the Dutch possessions are equal to twice the area of New South Wales, or seven times the state of Victoria. Within this island-empire are to be found all the products of which the Tropics are capable. It is an important, promising region, the most of which still awaits exploration and development.

2. *Surface and Vegetation*

In population and productivity Java is easily the most important island in the group. It is built almost entirely of volcanic rock which weathers very rapidly in the warm, moist climate, and thereby furnishes the constituents of the very fertile soils which have given the island the name of 'the Garden of the East'. The alluvial lowlands are almost entirely devoted to different forms of tropical agriculture in which rice-growing, carried on by an almost unique system of irrigation, is predominant. Other important crops of the plains are sugar-cane, maize, tobacco, cassava, potatoes, and other tubers. Coco-nut palms, kapok trees, and many kinds of tropical fruits are prominent in every lowland landscape. These are the regions that mainly support the thirty-seven millions of Java's population. Beyond the alluvial plains are the foot-hills, where, on the volcanic formations, every foot of ground is put to good use. The terraced and irrigated 'sawahs' or padi-fields alternate with fruit such as pine-apple, rubber, tea, coffee, and many other plantations. Where the volcanic soil gives place to limestone the great teak-forests appear. Above this region again the so-called 'mountain cultures' extend to a height of about 5,000 feet above sea-level; and here plantations of tea, coffee, cinchona, vegetables of various kinds, and suitable grains complete the wonderful Javanese agricultural system. Extensive patches of grassland are also common in the uplands, and these naturally have become grazing areas.

Under the tutelage of the Dutch administration all the resources of agricultural science are brought into play, and very strict regulations have to be observed by the cultivator in order that the fertility of the soil is not impaired by exhaustion. The rotation of crops, proper irrigation methods, choice of seed and fertilizers are all closely watched by administrators. It is in fact the greatest experiment in intensive cultiva-

FIG. 22. 'THE TERRACED PADI-FIELDS (SAWAHS) OF JAVA

The wonderful system of cultivation built up by the natives through centuries is carefully fostered by the Dutch administration. As the land rises from the lowlands the 'culture' system passes through sugar, rubber, coffee, tobacco, and cinchona belts

tion that the world has to show. In the rice-fields and plantations agriculture is carried on in a manner almost incredible to those accustomed to the methods of extensive cultivation employed in Canada and Australia. Each plant is attended to separately; the garden or field becomes a nursery in a very real sense. At certain times long lines of patient labourers—men and women—work through the rows of growing plants, loosening the soil and removing the insect pests on each individual plant. Machinery is almost unknown, and the maximum result is obtained from the soil by sheer force of human muscles.

On the other islands, known usually as the Outlying Possessions, nothing so highly developed as the Javan system is to be found. This will be appreciated when it is mentioned that Java, comprising less than 5 per cent. of the total area of Insulinde, has over 70 per cent. of the total population. By comparison, then, the Outlying Possessions are undeveloped and uncultivated. Most of the surface is still covered in primeval forest or poor grass, and only on the coastal margins has agriculture been undertaken. The chief reason is that the fertile, basalt soils of Java are lacking in Sumatra, Borneo, Celebes, and New Guinea. Another feature of most of the islands tending to retard development is presented by the vast tracts of mangrove swamp which, in East Sumatra and along the entire coast of Borneo and many of the other islands, lie at the back of the coast-line.[1] Agriculture is everywhere determined by the amount of rainfall, which is, in turn, decided by the height and direction of the mountain ranges. Even in this region of tropical, oceanic climate, therefore, there are extensive patches lying in rain-shadow and forming

[1] The mangrove is one of the most interesting features of tropical coast lands. This tree spreads by dropping branches to form roots, and these trap the silt brought down by the rivers. The mangrove is, in this way, the chief agent in building up silt deposits that will later become fertile alluvial plains along these coasts; and no other tree is capable of growing in salt water or of accomplishing this very important reclamation work.

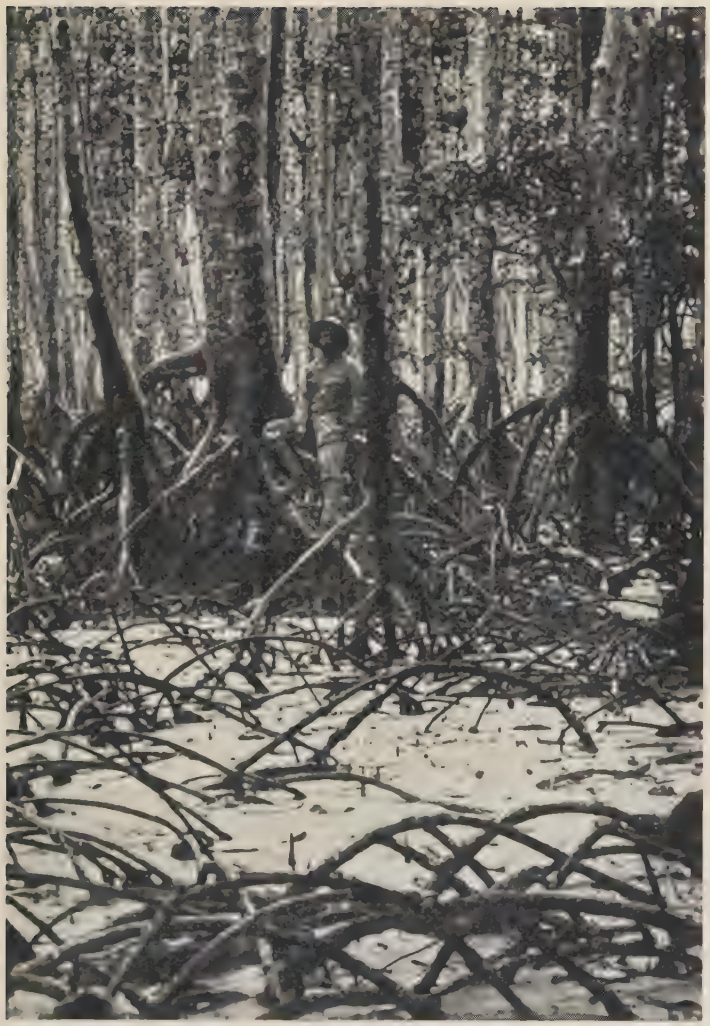

FIG. 23. A MANGROVE FOREST

On the east coast of the Malay Peninsula. Typical of the low-lying coasts right through Malaysia, N. Australia, and Central America. Nature's great 'reclamation plant' at work

areas of poor grassland. In Java itself the variation in rainfall from year to year is a problem for the cultivator. Sometimes the rain falls right through the year, while at others long drought periods stretching over several months may occur.

FIG. 24. 'SIGN AND TOKEN OF SOME ELDEST NATION'

The enormous stone-terraced temple rising like a great carved pyramid from the rice plains at Borobudur is a monument left by an ancient Hindu colonization of Java

3. *Government*

The Netherlands Indies are controlled directly by the Dutch Government through a Governor-General who has the aid of an official advisory council, upon which the natives have a minority representation. The system adopted is somewhat similar to that of the British administration of India. There are thirty-seven provinces: over each a Governor or Resident is the chief authority with very extensive powers. Many of the native states are virtually self-governing communities where the power of the Resident is limited to supervision

and advice, and where connexion is maintained by treaties between the rulers and the Dutch Government. A highly trained civil service, the chief posts of which are in the hands of Europeans, has been developed. The former harsh rule

FIG. 25. THE FAMILY DWELLINGS OF SUMATRA

Beautifully built and decorated, these houses are added to as the sons and daughters marry. Each roof peak represents such an addition

which amounted to exploitation of the natives has given place to a much more enlightened administration in which public education, health services, the promotion of agriculture, and the supervision of the welfare of the natives are prominent features.

4. *Agriculture*

The cultivation of sugar has become the foremost primary industry, and owing to scientific investigation and experiment the area under cane has been doubled in the last twenty years. The cane-sugar industry of Java now ranks among the most efficient in the world. Rubber-plantation is of such recent development that its rapid progress is amazing. If the area under rice is excepted, half the acreage under cultivation is now planted with rubber trees. Tea has become the most important of the mountain cultures, and is mainly carried on in Java and Sumatra. Javanese uplands are also the chief areas in the world for the production of cinchona from which quinine, so important for the campaign against malaria in the tropics, is extracted. Cocoa, coffee, copra, sisal-hemp, kapok, cassava—a root from which tapioca is prepared—maize, and soya beans are the other chief commodities of commercial production. The production of rice, although enormous, is insufficient for the local food supply; and production is being encouraged by every possible means and extended wherever land is available. To this end, irrigation, originally carried on by the natives whose primitive methods still water over half the total rice area, is now being systematically developed along modern lines.

In this connexion afforestation forms one of the chief means by which the Dutch government in the East Indies is conserving water supplies. Forestry is receiving a large amount of close study, and the great teak forests so wastefully depleted in former years are gradually being restored to their former extent and efficiency. Teak flourishes on the poorer soils that are almost useless for agriculture, and the timber is invaluable for many purposes in the tropics. Durable, strong, and comparatively light, it is one of the few timbers that resist the attack of that scourge of hot lands, the termite or white-ant. It is used very largely for houses, for railway-

sleepers, in shipbuilding, and for many other purposes. Its value is so great that all other trees are classed as 'wild timber', and they are mainly regarded as being of service in protecting the water-catchments.

The Dutch islands are recognized as being very rich in minerals, especially tin; and most of the metals are known to occur in commercially payable deposits. The chief interest centres in the alluvial deposits of the small islands of Banka, Billiton, and Singkep, where the output of tin is only second to that of Malaya. Here, too, the work of recovery is mainly in the hands of Chinese. Important coal and mineral oil-fields are known to exist, and some of these are already being profitably worked. Coal production reaches about $1\frac{1}{2}$ million tons annually, and very large reserves are known to exist in Sumatra, with beds up to 25 feet in thickness. The chief oil centres are in Borneo, Palembang, East Sumatra, Sourabaya, and Amboina. The Dutch East Indies (1927) take seventh place in the list of oil-producing countries, with a yearly output of crude petroleum which is equivalent to about 1·7 per cent. of world production. The fields are considered by experts to be capable of considerable expansion, and a large refining and distributing industry has already been established.

Chapter X

NEW GUINEA

1. *Physical and Climatic*

New Guinea is a great undeveloped territory lying close to the equator, and extending in a south-easterly direction for a total length of nearly 1,500 miles. Its greatest width is about 500 miles. Structurally the island belongs to the Australian system of which it is a northerly extension. It embraces an area of 300,000 square miles, about the same as

that of New South Wales. It is wholly tropical in character, and possesses every variety of surface from low-lying, swampy and densely-forested plains drained by a network of rivers, to towering summits 15,000 feet above sea-level. A complex mountain system runs right through the island, occupying, in the main, the northern half and the northward and southward peninsulas. This main divide is known variously as the Nassau Mountains in Dutch New Guinea, and as the Victor Emanuel, Bismarck, and Owen Stanley Ranges in British territory. In the south-east it becomes the backbone of a peninsula over 300 miles long. The greatest heights are reached in the Nassau Mountains, but Mounts Blücher, Scratchley, and Victoria are all over 13,000 feet.

The well watered, deltaic plains of the south side form a great contrast with this mountain region. The largest rivers in the island are found in this southern division for which they form the only highways. The Fly River flowing into the Gulf of Papua drains the greatest basin, and is navigable for small vessels for more than 500 miles. Other rivers of importance in the southern lowlands are the Turama and the Purani, and all enter the Gulf of Papua by extensive deltas. On the north side of the island there are several splendid streams flowing through extremely rugged country which everywhere extends almost to the coast-line, and renders the north coast in general higher and more broken than the south. Between the main divide and the sea are many coastal ranges which merge into grassland or savannah and drop steeply into a swampy coastal plain of true jungle type about 50 miles in width. The mountainous character of the north side is responsible for the fact that it is even less explored than the south. Much splendid alluvial land of enormous fertility exists along the coasts and river-valleys, but the climate is unhealthy in the extreme. The Mamberano River is the next in point of size to the Fly River and drains a great basin of 23,000 square miles. Most of the rivers in Dutch territory are navigable only for

short distances since the upper courses are much broken by rapids; but the Sepik in the Mandated Territory is navigable for small steamers for 300 miles and for ocean steamers for about a third of this distance.

Over such a vast area rainfall conditions vary very much; but, in general, the north-west monsoon brings the main

FIG. 26. VILLAGE IN PAPUA

Compare this with the Malay Village (FIG. 15). Note the frizzy-haired Melanesian types, the coco-nut palms, the houses, and the fishing-nets

rainfall, while the period of the south-east monsoon corresponds to the dry season which in certain districts may develop into serious drought. On the whole the precipitation is heavy, but is greatly influenced by the height and direction of the ranges. In some areas, particularly in the east, the south-east monsoon brings the chief rainfall, but there is no pronounced dry season. The annual fall is nearly everywhere in excess of 80 inches, but variations from as high as 250 inches to as low as 66 inches are known to occur in New Guinea itself. Humidity is very high, with an average at most settlements of over 70 per cent. over the whole year.

The coast regions in particular are notoriously among the most unhealthy regions in the world. The mosquito-ridden swamp areas are particularly dangerous to Europeans, but malaria is prevalent all over the island up to heights of 2,000 feet.

2. *People*

The natives of New Guinea and the adjacent islands differ very markedly from those of the remainder of the East Indian Archipelago. The general name of Papuans, from a Malay word meaning 'woolly-haired', is applied to them all; but a distinction is to be made between two main groups, who are labelled as Papuans and Melanesians. The Papuans proper belong mainly to the interior and are presumed to be the aboriginal race. They are very closely allied to the aboriginals of Australia. They are forest tribes with a totem system very similar to that found in Australia, and have all the debased characteristics of the primitive savage, including a propensity for tribal warfare and cannibalism. Some pygmy tribes have an average height of only 4 feet 8 inches. The Melanesians, who are mainly coast-dwellers, are in general darker and frizzy-haired, while in the smaller islands a great admixture of Polynesian, Malay, and even Chinese has taken place. This is merely a broad classification which does not attempt to account for the great diversity of

FIG. 27. A NATIVE OF PAPUA
From a coastal tribe. Note the thick frizzy hair typical of the Melanesian

colour from light brown to intense black, nor for the extraordinary number of languages found in the island.

The natives in the settled districts have been induced to abandon their old tribal warfare. Most of them are energetic and of good physique; but are very susceptible to the tropical diseases so prevalent in the island. The western and coastal peoples are, generally speaking, taller and better-developed than those living in the interior. They live for the most part in villages which may comprise merely half-a-dozen houses or a settlement of over a thousand people. Many of the tribes in the centre and the west have very large communal houses. In the Fly River district, in particular, a great number of families will inhabit a large dwelling over 500 feet long and divided into compartments for each family. Architecture and carving is of a high order, and the bow and arrow are the principal weapons. No reliable estimate of the numbers of natives has been made; and, although the island possesses a large population, extensive areas are quite uninhabited. A competent observer in Atlee Hunt makes the following observations:

'It is altogether a mistake to regard the natives of New Guinea among the lowest class of savages. It is true that the practice of cannibalism formerly prevailed extensively, and it is believed to exist still among some of the tribes who yet remain beyond the sphere of governmental influence; but against that must be set their permanent villages, the high degree of excellence attained in house-building, their skill in boat construction and navigation, the culture of "gardens"—as their large, well-kept fruit and vegetable plots are called—the possession of a just and minute system of laws as to ownership and property generally, their family affections, the care for the aged and infirm, their abstinence from all forms of intoxicating liquor, to say nothing of many other attributes the possession of which shows that they are far from being the hopelessly irreclaimable savages they were formerly believed to be.'

3. *Vegetation and Agriculture*

Both the fauna and flora of New Guinea are truly Australian in character. The animals include such distinctive types as the egg-laying mammals and the marsupials. The Asiatic types of Borneo and the western archipelago are absent, most noticeably the monkey types. Birds such as the cassowary, the scrub-turkey, and the parrot in endless variety also display the natural affinity with the mainland of Australia. A peculiar and characteristic species, however, is the gorgeously coloured bird of paradise, which has suffered so greatly as a result of the contact of New Guinea with civilization. The vegetation is also largely blended with Australian forms such as the eucalypt and acacia. The whole area of the island is almost entirely forest-covered. Tall trees are found at a height of 8,000 feet, while a species of pine grows as far up as 10,000 feet. The island abounds in plants and timbers of a high economic value, but no serious attempt has yet been made to exploit or even to survey the great resources of New Guinea. More than 120 varieties of useful timbers are known to exist, of which the dense *ulabo* which resists the white-ant is at present the most important. The delta country is covered with a thick jungle of *nipa* and *pandanus* palms and other trees, tangled in a riotous mass of rattans and other creepers. The coast vegetation is mainly of mangroves and palms.

The immensely fertile valleys and plains afford great possibilities for the development of tropical agriculture. By reason of the distribution of good soils at varying elevations, every tropical commercial crop can be grown in the island. Coco-nuts, rubber, and sisal-hemp are the main plantation industries so far established. Coffee, cotton, vanilla, kapok, cocoa, tapioca, cinnamon, tea, and tobacco are all being grown successfully; but their culture has not yet been attempted on a large scale. Sugar-cane, nutmegs, bananas, yams, bread-

fruit, ginger, and many edible fruits are also widely grown. The main food of the natives in the south is sweet potatoes, while in the west it is mainly sago, which is obtained from the nipa palm. Rice is scarcely grown at all, and tropical agriculture on scientific lines has scarcely begun. The best

FIG. 28. STONE-AGE MAN IN PAPUA

Negroid types from the interior

varieties of sugar-cane on the Queensland plantations have their origin in the gardens of New Guinea natives.

4. *Minerals, Settlement, Government*

New Guinea is also believed to be very rich in minerals, but their diversity and extent, especially in the mountainous north, are at present almost unknown. Gold, copper, silver, lead, zinc, osmiridium, and graphite are some of the deposits that are already being worked. Coal is known to exist in many places, and the search for petroleum is being diligently carried on.

Politically the island is divided into three areas. The western half forms a Dutch possession, and is the least developed and mainly unexplored. The territory is administered from *Ambon* on the neighbouring island of Ceram. South of the mountains, lying around the Gulf of Papua and extending through the south-eastern peninsula, is the dependency of the Commonwealth of Australia known as Papua (pron. Pah-pooer). The remainder of the island was formerly a German possession, but it is now administered by the Australian Government under mandate from the League of Nations as the Mandated Territory of New Guinea.

The main settlements of importance are the trading and administrative centres situated round the coasts. *Port Moresby* is the capital of Papua, situated on a fine harbour to the east of the gulf. *Samarai* is a small island off the south-east extremity of New Guinea which has become a trading centre for several adjacent groups of small islands. The chief centres for the Mandated Territory are *Eitape*, *Madang*, and *Morobe*, all trading settlements on the mainland, while the administrative centre is at *Rabaul* in New Britain, a well-planned town in a low-lying situation, with an important trade in copra.

Other settlements are mainly along the coast of the mainland and larger islands, since all traffic is water-borne. Many of the upland districts, however, are bound to become very productive regions when the great problem of transport is solved. The railway may yet do for New Guinea what it has already done for Central Africa. The lowlands, again, are the ideal situation for the coco-nut palm; and, as copra is at present the mainstay of the territory, the development of the highland areas is not likely to be rapid. In fact the thousands of small islands in the archipelago offer greater chances of profit to the commercial planter, since they present every variety of soil and situation, are largely free from the insect pests that make life on the mainland so unpleasant, and are

closer to the sea—the universal highway. Many of these islands are low-lying and of coral formation, the natural home of the coco-nut palm. The larger islands, on the other hand, contain hilly areas of heavier volcanic soil, and rich alluvial flats in addition, so that almost any tropical product can be grown somewhere.

Apart from transport the chief problem of the planter is the supply of labour. The different native peoples vary very greatly in their adaptability to plantation conditions, and the press-gang methods of the past did not have the effect of securing good-will towards the planter. The control of native labour in the areas under British jurisdiction is now very strict. Regulations for health services, clothing, housing, hours of labour, and proper supervision ensure just and generous treatment. Recruiting of healthy natives over the age of twelve years is permitted, but the period of indenture must not exceed three years, after which the native must be returned to his village. Steps are being taken to provide education for the natives, and more especially to give instruction in tropical agriculture. Under the terms of its mandate the Australian Government is obliged to administer the territory in such a way 'as to promote to the utmost the national and moral well-being and social progress of the inhabitants', and no effort is being spared to fulfil the obligation completely.

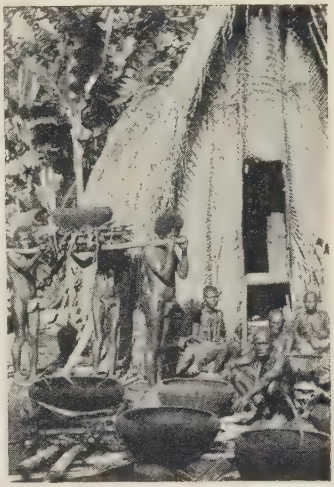

FIG. 29. NATIVE LIFE OF PAPUA

Primitive tribe of the interior. Note the negroid features and the communal house

5. *Dutch New Guinea*

The development of Dutch New Guinea is not so far advanced as that of the rest of the island. In the west and on the coasts of Dutch territory are many coco-nut plantations, and the natives trade freely in nutmegs, gums, and sea-products such as shells and trepang. The traffic in bird of paradise plumes, mainly with the Chinese, is confined to Dutch possessions since it is strictly forbidden in British territory. The policy of development that has been carried out so successfully in Java is, however, to be gradually extended to Dutch New Guinea; and exploration is being pushed forward. The natural features of the interior make communication extremely difficult. The main mountain chain divides the north from the south, while the deep gorges of the rivers make overland transport a matter of great difficulty, apart altogether from the problems presented by dense jungle, steamy climate, and treacherous natives.

BIBLIOGRAPHY TO PART II

Gibson, Ashley: *The Malay Peninsula and Archipelago*, 1920. (Dent.)

Winstedt, R. O. (Edit.) *Malaya*, 1923. (Constable.)

Knowles, Lilian. *Economic Development of the British Overseas Empire*, 1924. (Routledge.)

(Contributed.) Vol. ii. Asia, *Other Possessions*, pp. 338–453 in the Oxford Survey of the British Empire. (Clarendon Press.)

Torchina, H. A. *Tropical Holland*, 1923. (University of Chicago.)

Foreign Office Handbooks: No. 82, *Java and Madura.*
H.M. Stationery Office, London, 1920.
83, *Sumatra.*
84, *Dutch Borneo.*
85, *Celebes.*
86, *Timor and Sunda.*
87, *Dutch New Guinea.*

Murray, Sir Hubert. *Papua of To-day*, 1926. (King.)

PART III
AUSTRALIA

Chapter XI
PHYSICAL AND CLIMATIC

1. BUILD AND SURFACE

Although the newest of the continents in point of discovery and settlement by European races, Australia is one of the oldest geologically. The great movements of upheaval, and the restless volcanic activity still evident in other parts of the earth's crust, died out long ago in Australia. Upon its vastly old rock masses the forces of wind and water have been at work so long that all traces of youth have now vanished. The general level is consequently much lower than that of any of the other main land-masses, and this fact alone is a dominant factor in determining the general conditions of life in the continent. As everywhere, the geological and physical build control the distribution of plant and animal life to such an extent that a study of the arrangement of highland and lowland is necessary to a proper understanding of the human responses.

If we except the South Polar continent, Australia is the most isolated of the world's great land areas. Contact with any of the large centres of population involves long voyages by sea that merely emphasize the geographic loneliness of the 'great south land'. This isolation in itself was, of course, a prime factor in retarding the discovery and settlement of Australia. It is, nevertheless, a big but compact land-mass of about 2,400 miles in east to west measurement, and a little less than 2,000 miles in greatest length from north to south,

giving a total area of approximately three million square miles, or about the same as that of the United States or Canada.

The surface may be regarded as falling into three well-defined divisions: (i) the Western Plateau, composed for the most part of immensely old rocks, and extending over nearly

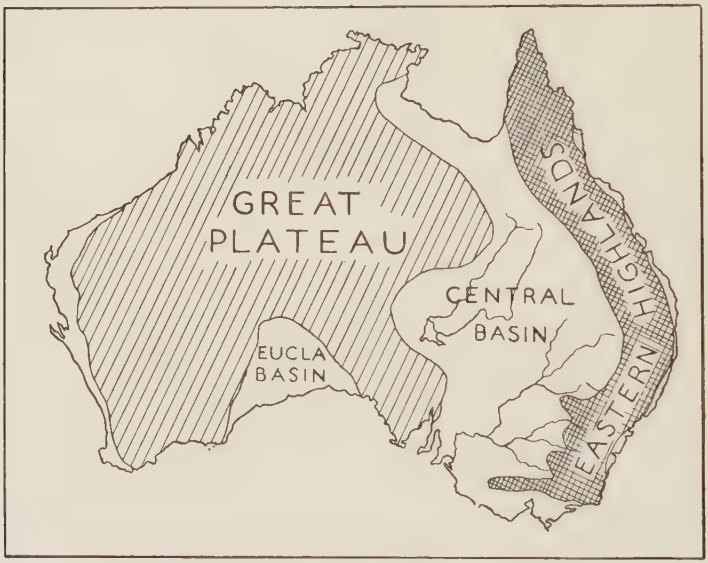

Fig. 30. AUSTRALIA, PHYSICAL

half the total area of the continent; (ii) an Eastern Highland region, comprising the remnant of an old alpine system now much planed down and levelled by erosion; and (iii) an intermediate lowland area, the surface of which is composed largely of the sediments carried down by the erosion of the highland areas and deposited in an ancient sea-bed. Each of these will be examined more closely as a preliminary to a discussion of climate and weather.

1. *The Western Plateau*

This great area standing at an average height of a little less than a thousand feet above sea-level, and composed of some of the most ancient rocks in the world, forms one of the main continental blocks. It is, as it were, an old, hard anvil against which the surrounding parts of the crust have been crushed and contorted. As a result of the extreme dryness of the climate over most of the plateau the general surface is unusually level. Wind erosion, in particular, has been very active; and the loose soil has filled up the depressions and smoothed out the surface of the country. The area is rather like a huge flattened lemon-squeezer, with a very low rim and central bump; and so most of the drainage is inland, although the very heavy evaporation and scanty rainfall is against the formation of rivers. The plateau is fringed on the coastwise edges by a narrow plain formed by the alluvium carried down by the rivers draining the seaward slope or, as in the north-west, by the *loess* blown seaward by the prevailing winds. Even the coastal rivers, however, are poor as rivers go, since, in the dry season, they become mere chains of water-holes or even dry channels for months at a time.

2. *The Eastern Highlands*

Lying right along the eastern coast is a second highland area of a very different kind. The ancient mountain fold-line, much worn down by weather forces, was, during a great period of volcanic action, repeatedly shattered and upheaved into a newer mountain system of true alpine character with great snow-peaks and glaciers. These again have been planed down by erosion until the region is now a great succession of plateaux—the mere stumps of their former greatness. The whole line of highland, from Cape York to the Hartz Mountains far to the south of Tasmania, is a great battle-ground on which the forces of nature—the explosive forces of vulcanism working for uplift, and the slow persistent forces of weather-

ing and erosion—have wrestled for countless years. The greatest heights of the present cordillera are in the south-east corner, but they represent 'mere humps upon the surface of the eastern highland plateau'.

Farther to the north the plateau presents towards the Pacific that steep, scarp-like face that proved such a barrier to the earlier settlers, confining them as it did to the narrow coastal strip until Blaxland, Cunningham, and others discovered the gateways to the interior. Over this escarpment the plateau proved to have an even surface, dissected by the gorges of the streams, but sloping back gently to the central plains. The gaps in the plateau edge have become the main gateways leading from the Pacific coast to the hinterland. These are, from the north—the Cassilis Gap behind Newcastle, the Lake George gateway near Canberra, the saddle on which Cooma stands, the pass through the Australian Alps by Omeo, and the Kilmore Gap due north of Melbourne. Still farther north in Queensland the highland region is rolled out, as it were; and is generally lower than the southern half of the cordillera, except where it fronts the coastal edge in the Atherton Plateau and the ranges behind Maryborough. The whole seaboard in its drowned-valley harbours and barrier reefs bears the marks of subsidence in that final extensive movement by which Tasmania was detached from the mainland.

3. *The Central Lowlands*

The central depression between the eastern and western highlands is one of the largest expanses of true plain country that exist. It comprises a series of shallow drainage basins stretching from the Gulf of Carpentaria to the Southern Ocean, and from the Darling Downs to the west of Lake Eyre—a great expanse covering almost a third of the continent. The clay soils of the plains north of Lake Eyre are composed of sediments deposited in an ancient sea

that submerged this region, and may once have completely divided the continent. Part of the area drains north into the shallow Gulf of Carpentaria, but the major portion belongs to the inland drainage system of Lake Eyre. Both now form what is called the Great Artesian Basin from the presence of the subterranean water upon which the region is so dependent. A second basin lies in the south-eastern curve of the Great Divide, and drains away through the wide deltaic flood-plain of the Murray and Darling rivers, and the old raised sea-bed which lies between the confluence and entrance to the sea. Hence it is known as the Murray-Darling Basin.

A minor highland system that is nevertheless of much economic importance lies to the west of the Murray-Darling Basin, and is separated from a south-easterly extension of the Western Plateau by the Great Rift Valley of South Australia in which lie Spencer Gulf and Lake Torrens. This is the system known as the South Australian Highlands, which terminates to the north in the Flinders Range and to the south in Kangaroo Island. Still another basin is scooped out of the southern edge of the Western Plateau, and forms that weird monotonous level across which the transcontinental railway is thrown between Adelaide and Perth, and which goes by the name of the Nullarbor Plains.

II. THE CLIMATE OF AUSTRALIA

In a country of such broad extent, ranging as it does from within 10 degrees of the equator to nearly 30 degrees closer to the South Pole, a great variety of climate would be expected. The Tropic of Capricorn marks about the central axis of the continent; and, speaking generally, the climate for such a great land area is remarkably uniform. The insularity, the lack of high elevations, and the circulation of adjacent waters are other factors which help to regulate the climate of Australia. This may be described generally as warm to hot,

but it is much cooler on the whole than other regions in corresponding latitudes. Only in the cooler temperate regions of the south-east and south-west, and in the highlands, is the cold season at all well marked. By way of contrast it is only on the coastal lowlands within the tropics that physical discomfort actually retards white settlement.

The insular position of the continent and the greater east to west extension of the land-mass, together with its smaller area as compared with other continents, account for the fact

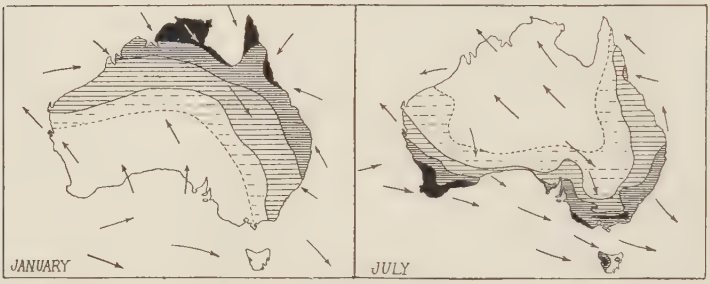

FIG. 31. AUSTRALIA, RAINFALL AND WINDS

Black denotes the area of heaviest rainfall. The belts shown receive (January) 10–20, 4–10, 2–4, 1–2 inches and (July) over 5, 4–5, 2–4, 1–2 inches, respectively

that only a comparatively small portion of the whole area is more than 500 miles from the nearest ocean, and that the moderating influence of the ocean is carried far inland. On the eastern coast the warmer conditions are carried as far south as Tasmania by the East Australian branch of the Equatorial Current. The relatively drier west side and the greater part of the southern coast come under the influence of two branches of the main cold westward drift which sweep round to unite south of India. The relatively low elevations, furthermore, are not such pronounced obstructions as the great cordilleras east of the Pacific present to air circulation.

The dominant climatic influences, therefore, are the two great wind systems, viz. the tropical trade-wind circulation in

the north, and the westerly wind system in the south. The connexion between these and the swing of the whole system north and south with the sun have been dealt with elsewhere. Viewed broadly, the result is that in the warm season, i.e. from November to April, the equatorial currents are drawn down over northern Australia; and at the same time the Westerlies are pushed far to the south of the continent. In the cool season, i.e. from May to October, the equatorial system swings away over Asia; and the Westerlies are dragged so far north that the southern half of Australia comes under their influence. This great change brings about the characteristic seasonal variations for the whole of Australia, and determines the distribution of the rainfall in a well-marked manner.

The inflowing winds over northern Australia in summer bring the heavy monsoonal rainfall which is such a contrast to the cool season of off-shore winds in the rainless months. The coastal areas fronting the highlands in Queensland and along the north coast thus receive the heaviest rainfall in Australia; but, except for the Queensland coast, the alternation of rain and drought is a very real handicap to development. On the other hand the Westerlies encounter the whole south coastal area in the cool season, after blowing over the great uninterrupted expanses of the Southern Ocean; and the heavy winter rainfall, which presents still another contrast to the summer drought, is the result.

Generally speaking, the winds on the Pacific coast are onshore for most of the year, and represent the play of the Trades as the whole system moves north and south. The presence of the warm current flowing to the south along the edge of the continent has a particular significance because these winds bring ashore the warm saturated air which slows down in passing over the coastal highlands of the Great Divide. Hence the plentiful and reliable rainfall so evenly distributed throughout the year on this coast. On the contrary, the southern and western shores of the western half of Australia

are subject to winds flowing over cold currents before they reach the land. The air temperature is raised as it passes overland, and consequently these winds tend to absorb rather than deposit moisture. The contrast is pointed by the rainfall figures, e.g. Eucla with 10 inches annually is to be contrasted with Sydney in about the same latitude, but with an annual fall of about 50 inches.

A striking feature of the climate of southern Australia is

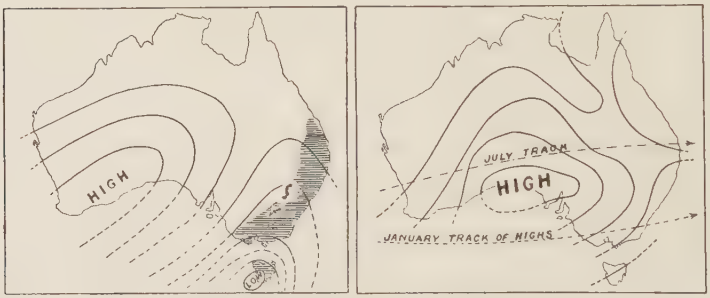

FIG. 32. 'HIGHS' AND 'LOWS' OVER AUSTRALIA
Rainfall shaded

the association of the rainfall with storms known to meteorologists as 'lows' or cyclones because of the low barometric pressure and the generally circular movement of the winds in the systems. We may regard cyclones as huge eddies in the atmosphere carried along in the main current, not unlike whirlpools in a fast stream, each whirlpool revolving round its own centre, and at the same time being carried along as a whole. Cyclones develop particularly in the stream of the Westerlies, and are the main factor in the storms of the areas they affect. They move in an easterly direction at varying speeds, but the precise track followed is by no means constant for different cyclones nor regular for any one cyclone. In an effort to 'fill the low', air from all directions flows into the area of low pressure in a spiral fashion; and, in a longer or

shorter time, the 'low' passes over and is succeeded by some high-pressure system. It follows that a place in front of a 'low' will get winds from a direction which is almost the opposite of the direction after it has passed. Hence the sequence of weather changes experienced by places in the cyclonic zone, i.e. warm Northerlies followed by squally Westerlies and, later, by cold southerly winds.

These disturbances affect the southern half of the continent with remarkable regularity, sometimes crossing farther to the north and drawing the cold southerly influences far inland, sometimes passing farther to the south and leaving the interior and southern areas open to tropical influences. As the 'lows' pass eastward they are followed by southerly winds with cold rains and snow in the highlands. The high pressure then gradually asserts its control and brings clear, settled weather accompanied, in the winter, by frosts. The margin of a 'low' may develop between two 'highs' as a trough or tongue stretching to north or south. In the warm months monsoonal conditions are thus occasionally drawn as far south as Tasmania.

Chapter XII

PLANT LIFE

1. *Native Vegetation*

The seasonal contrasts between the northern and southern parts of the continent are no greater than those between the coastal and inland regions. The tapering rainfall from coast to interior exerts a corresponding control on the natural vegetation; and, in general, we may say that the density and size of plant growth decreases in proportion to the distance from the sea. The chief exception is, of course, due to the presence of highlands with correspondingly greater rainfall. It will be useless to look for the great diversity of plant types

that is found in other lands which extend, like Australia, from tropical to cool-temperate conditions; for the contrast between the evergreens of the tropical zone and the deciduous trees of the temperate is not found here. The plant life belongs mainly to one large family, and the species merely

FIG. 33. RAINFALL RELIABILITY

represent types that have become adapted for differing climatic conditions.

Nor is the reason of this far to seek. The continent has been isolated from such early times that those types of plant and animal life which have been killed-out in the other continents by the competition of higher types have here been sheltered and enabled to survive. In fauna and flora Australia displays a succession of strange and primitive types that make

the continent a museum of antiquities. This is particularly true of the main family of plants, i.e. the eucalypts or gums. Here we have a great variety within a sameness that embraces the whole continent. The bark, leaf, and flower systems of the great vegetation types are very similar from Cape York to southern Tasmania. The family ranges from the giant swamp gum of the lowlands to the stunted snow gum of the plateaux. From the great gnarled specimens of the inland river valleys to the slender dwarf mallee, from the tall, hard jarrah of Swanland to the softer species of the mountains, everywhere the gums in endless variety but in apparent sameness form and adorn the bowery Australian bush. In density the forests of the continent vary greatly; but they reach their best development in the well watered regions of the south-east and south-west. Another large family, the acacias, is also peculiarly adapted to withstand the arid conditions of the desert margins, and ranges from the mulga of the west to the beautiful golden 'wattle' of the south-east and the twisted brigalow of the north. Still farther inland even the acacia gives place to such drought-resisting plants as the saltbush and spinifex.

It will be seen that, for plant life, conditions are much the same over the whole continent, for everywhere there is a long dry season to be endured. In the far north, however, still upon a basis of eucalypts, the true tropical forest, or 'vine-scrub' as it is called in Queensland, occurs wherever rainfall is heavy and reliable enough. Dense thick tree growth interlaced with a great wealth of creeper, and decorated with ferns and parasites, occurs on the rainy seaward slopes. Beyond the coastal region the drier interior conditions are the cause of a change from tropical forest to the more open savannah in which the trees get fewer and smaller as the true desert is approached. This tapering rainfall is well brought out in figures showing the annual rainfall in inches from Darwin inland to Alice Springs.

The problem of settlement is largely comprised in converting bush land into farms, i.e. in turning forest into grassland. This destruction may be useless since it is often found, after clearing, that the area is fitted to produce trees and nothing else. This is particularly the case in the hill sections of the eastern highlands where uncontrolled deforestation has had far-reaching effects, especially upon the flow of streams. The undergrowth and debris of the forest floor acts as a sponge to retain moisture, as a mat to retard evaporation, and as a protective pad against erosion. Forests act as regulators, 'strainers', and purifiers of the surface water, and allow the water to drain slowly into the channels. When the forest is removed rainfall runs off the surface immediately, taking with it the top-soil by sheet-erosion. The creeks and rivers run 'bankers', but the channels become choked with the rubbish swept down from the higher levels. Worst of all, the summer-winter balance of the river flow is destroyed, and the streams tend to dry up in the summer months.

Wood, in some form or other, is for man a prime necessity; and the further he advances the greater becomes his dependence upon the forests. For timber in the wide range of his constructional work, for pulp in paper-making, or as cellulose for the manufacture of artificial silk, he is every year making heavier and heavier demands upon the forest resources. In the light of the urgent needs of the near future Australia cannot be regarded as a well-forested country. A modern community can manage by devoting at least 5 per cent. of its area to forests: Australia's percentage is barely $1\frac{1}{4}$, or one-fourth of the proportion necessary. The influence of selfish commercial interests and the apathy concerning forest problems, such as the dreadful waste every year through bush fires, is reducing even this margin by hundreds of thousands of acres each year. The ruin and waste of the past defy description, and the damage in many places can never be repaired. Forestry in Australia is yet in its infancy, but more

serious attention is already being devoted to its urgent problems. The best forests have gone beyond recall, but it is still possible to save something from the wreck.

The serious deficiency in Australian forests is in those trees which yield softwoods, and an essential part of forest

FIG. 34. MAN THE DESPOILER

Tree cemeteries of this type are all that remain when the attempt to turn natural forest land into farms has failed. Trees gone and soil going

policy in the Commonwealth consists in the planting of trees giving such timber. Tasmania probably offers the best opportunities for extensive planting with such trees as the Douglas fir and the Baltic pine. Timber from these varieties is imported every year into Australia to the value of about four and a half millions sterling, while the export of hardwoods amounts to about one and a half millions, a deficiency on the national account of three million pounds without considering another six millions paid for paper imports.

2. *Introduced Plant Life*

The planting of orchards is, of course, another form of afforestation. Exotic plants are introduced, and form the basis of fruit culture from pine-apples to pears, and from grapes to walnuts. The smaller berry shrubs form another important phrase of the process of substituting artificial for natural forest. Fruit-growing has now become one of the chief rural industries of the Commonwealth, and falls into four main groups: (i) the stone- and pip-fruits of the deciduous cool-temperate types, e.g. apple, peach, pear, plum; (ii) the fruits of Mediterranean types, especially the citrus fruits and the olive; (iii) the vine, which is another type so important that it must be considered separately; and (iv) the tropical fruits, such as bananas and pine-apples.

The industry as a whole is of comparatively recent development because of the problems of picking, packing, and transporting the product without damage. Only by improvement in methods and by the use of the refrigerator have these difficulties been overcome. The special incentive to fruit-growing in Australia is the fact that by means of cold storage it is possible for Australia to get fresh, ripe autumn fruit to Europe at the end of the northern winter. Climate and soil factors in Tasmania and in the hill regions of the south-east and south-west of the mainland are favourable to the apple, the hardiest of fruits, while the less hardy stone-fruits find suitable conditions where protection against frost is assured. Liability to frosts is a factor of importance in the location of fruit-growing, and largely accounts for the distribution of orchard areas in southern Australia.

The citrus fruits such as the orange find their best situation in the warm conditions of the Murray Valley and adjacent areas. The largest citrus area is found on the inland slopes of New South Wales, but the area may be regarded as con-

PUBLIC LI

tinuous along the Murray Valley into South Australia. The vine, too, as would be expected, is largely cultivated in New South Wales, northern Victoria, and South Australia for wine making, but in the Murray Valley as the basis of a great dried fruit industry. The tropical fruit districts are found in northern New South Wales and coastal Queensland.

FIG. 35. WHEAT HARVEST IN THE MALLEE

'Dry-farming' in the north-west of Victoria. Note the Mallee scrub in the background

These are the broad facts of climatic control over vegetation in Australia, and they have particular bearing upon the grave economic problem of settlement. It has been shown that alternating wet and dry seasons affect the whole of Australia with the exception of the east coast. In the southern areas the effect on agriculture is sufficiently marked, but the control becomes even more emphatic in the interior and the far north because of the very high rate of evaporation in those areas. But an even more fundamental feature of the

control can only be expressed by what Professor Taylor has called the reliability factor. Settlement is wholly dependent upon plant growth, which, in turn, is determined by rainfall and its distribution throughout the year. Now anything less than an 80 per cent. rainfall reliability will prove adverse to the cultivation of those plants upon which the white man is so dependent. Working on this broad principle, Professor Taylor has shown that the coastal areas of the north, and the southern corners of the continent plus a 'tongue' extending as far north as Rockhampton on the east coast, are the two regions which provide this indispensable condition of agricultural settlement (Fig. 33).

Lying inside this outer margin is a belt varying in width where the rainfall, while too unreliable for agriculture, is sufficiently reliable for pastoral settlement. In the heart of the continent is yet another block where rainfall is too scanty and too 'patchy' to be of any use for rural production, although even this statement needs modification for areas like the MacDonnell Ranges. Still, as a broad generalization, it expresses the main principle of climatic control. The bearing of rainfall on the three great primary industries of wheat growing, and sheep and cattle raising will now be examined.

Wheat is easily the most important grain grown in Australia embracing, as it does, 60 per cent. of the area under cultivation. It must be emphasized, however, that the area annually sown with wheat is less than 1 per cent. of the area of the continent. From what has been said earlier concerning the natural regions, we should expect wheat, which finds its natural conditions in the Mediterranean countries, to be confined to the similar natural regions of the south-east and south-west. The requirements of this grain are an upper and lower limit of forty inches and ten inches of rainfall, respectively, falling mainly in the winter and spring. These rainfall lines are shown in Fig. 31, and the wheat belt lies entirely within them. Wheat culture lies in a great crescent crossing

the south-west of the western plateau, passes (after a break north of the Bight) across South Australia, and continues along the inside curve of the eastern highlands. Thus the industry is confined to a great plain area that, on its inner margin, approaches aridity. The struggle in Canada to utilize every day of sunshine for the growing wheat is paralleled here by the attempt to conserve every drop of moisture by keeping the surface soil loose and broken. A new method of wheat-growing, i. e. dry-farming with summer fallowing, has in fact been invented to fit these conditions. Sheep are pastured on these fallows, and to provide water for stock and domestic purposes a huge system of open channels has been laid down which carries the water by gravitation for two hundred and fifty miles in the Mallee country.

The difficulties of procuring labour during the heyday of gold-digging, and the uniform character of weather and soil conditions, led to the invention of machinery for harvesting the crops. Development from reaper and binder to stripper or header, and so to the harvester which cuts, threshes, and bags the wheat, is another epic response by man to his environment. As in other lands of extensive cultivation, that is where labour has to be spread thin over vast areas, the machine has saved the situation and has enabled Australia to become one of the world's granaries. The average production of Australian wheat for the recent years was approximately 1 per cent. of world production, but the quantity exported represented one-eighth of the total volume shipped from all countries. Exports from the Commonwealth for five years, including flour, averaged ninety-three million bushels.

Something should be said concerning the relation between rainfall and yield. The methods of wheat-cultivation in Australia and in Canada differ, and the reason is to be found in the differing rainfall conditions. In Australia immediately after the first autumn rains (April or May) the seed is sown, and the months of winter rain form the critical

FIG. 36. DISTRIBUTION OF SHEEP AND WHEAT

Compare this map with Fig. 33 showing rainfall reliability

growing period. Thus for the south-east the rains of August and September, that is the spring rains, practically determine the yield. A steady increase in the yield per acre is following the spread of better farming-practice and the use of superphosphates. A fact of interest is the relation between Australian and Canadian wheats in the European markets. To produce the bread he requires the British miller combines Canadian red wheat with its relatively high gluten content with the softer Australian white wheat. Other countries producing similar white wheats are the Argentine, California, and India.

The production of oats has for many years been the mainstay of farmers in certain districts. The chief use is, of course, as food for horses, to which eleven-twelfths of the crop is devoted. The soil requirements of this crop are not unlike those for wheat. Oats, however, can stand nearly as much heat, and will thrive in wetter and colder conditions. Therefore this grain fits nicely into the climatic conditions of the colder and more elevated parts of the south-east and especially of Tasmania. Another variation of the production of oats is cropping for hay. This is not wholly confined to oats, for wheat and lucerne are grown for the same purpose. The greatest area under cultivation, excluding wheat, is that used for hay; and a very close dependence on the dairying industry is to be noted. The storage of green feed, ensilage, is now a well recognized part of Australian farm-practice.

Precisely the same effects of climatic control are to be noted in Australia as in the United States, where the zones of cultivation succeed each other in this order—wheat, maize, tobacco, cotton, sugar—moving from cool to hot conditions. So, too, in Australia there are many places north of the wheat belt with a suitable climate for maize and tobacco. Australia, despite the fact that the cultivation of both plants is of many years' standing, produces too little of either for home requirements. For the greater part maize is grown rather for fodder than for the grain which is absorbed mainly by such industries

as starch manufacture. Tobacco culture is in a somewhat similar position. Inferior varieties, unsuitable soils, fungus pests, and wrong methods of cultivation have doubtless proved adverse factors in development, and progress is very slow despite the enormous import of tobacco in various forms from abroad.

FIG. 37. FROM BUSH TO COTTON FIELDS IN QUEENSLAND

Shortage of labour especially at picking time is the chief difficulty

The cultivation of cotton is confined almost entirely to the State of Queensland, although attempts have been made to establish production in the Murray River Valley. A stimulus was given to the industry after the war, but lately there has been a decline. The area under cultivation (1928) is twenty-three thousand acres, producing about twelve million pounds of raw cotton per annum. The greatest difficulty has been that connected with labour since coloured immigration is not permitted in Australia.

The hot moist condition of the coastal areas of Queensland are also particularly suited to the cultivation of sugar-cane. An annual average of over 250,000 acres is under cultivation with a production varying around half a million tons. By virtue of the bounty paid to this industry by the Federal Government, it has shown such rapid development in the last two decades that the area now produces sufficient sugar for the home market and a slight surplus for export. The industry will, however, be considered more fully at a later stage. A series of experimental stations is performing excellent service in the development of the industry by demonstrating better methods of cultivation, and distributing improved varieties of cane.

Another crop of some importance is barley, which has a remarkable climatic range, flourishing equally well in the cool, wet Tasmanian or in the warmer, drier mainland conditions. The area cropped with this grain, which is largely used for malting purposes, is about the same as that under sugar-cane. In recent years South Australia has become the chief centre of production with more than 60 per cent. of the total crop. Here, again, there is a small surplus for export, but the close connexion with the Australian brewing industry is to be noted.

Chapter XIII

ANIMAL LIFE, POPULATION, SETTLEMENT

1. *Native Animal Life*

The influence of climate in controlling the character and distribution of plant life has another effect of the utmost importance to man. The nature of the trees, plants, and grasses determines, to some extent at least, the character of the native animals and also the type of animal which man can

introduce with advantage. The distribution of the animals introduced into Australia by the settlers will be considered presently in relation to climate and plant life. The native animals have, of course, an even closer dependence upon the original vegetation; and they include types unknown in other lands. They represent even more strikingly than do the native plants the survival of primitive forms which were protected by the isolation of the continent from competition against animals of a higher order. Scientists, and especially biologists, find in their structure and habits important chapters in the story of the evolution of animal life.

The native animals peculiar to Australia fall into two main groups: (i) the Egg-laying Mammals or Monotremes, the most primitive of all animals, represented by the duck-billed platypus and the spiny ant-eater; (ii) the Marsupials or pouched animals represented by types that have adapted themselves to such widely differing habits of life as those of the kangaroo, the phalanger or 'opossum', the wombat, and the bandicoot. All these are commonly found throughout the continent with local variations of size, colour, &c. So peculiar is the animal life that much speculation has arisen concerning the origin of the dingo or wild dog, which is an isolated case of an animal belonging to the higher order, and which almost certainly came to the continent with the aboriginal.

The bird life of Australia is also quite distinctive if not unique. Parrots and shrikes are found everywhere, but are paralleled by similar types in other countries. The kingfisher or laughing jackass and the magpie are common and characteristic. Others deserving of mention are the emu, a flightless bird about the size of an ostrich, belonging to the central plain, the cassowary, a somewhat similar type found in the north, and the black swan. Mention must also be made of the mutton bird, a curious migratory petrel whose habit of returning year after year to the same islands of the south-east has led to the peculiar industry of preserving the birds

in brine, chiefly for the Maoris of New Zealand, who consider them a great delicacy.

2. *Flocks and Herds*

As settlement takes place the universal tendency is for native life to disappear before the competition of imported animals. When he came to this continent the European found 'Stone-age' Man actually living as he must have lived thousands of years before in Europe. Scientists have for years been busy studying the life and customs of the Australian aboriginals ere they disappear before our advancing civilization as did the aborigines of Tasmania. All native life, even to fish, now seems to be in danger of extinction by other animals or by man himself. Several exotic animals have become pests. The rabbit, introduced by sportsmen, became so prolific and widespread that both the kangaroo and the sheep had to retire. Optimistic but fruitless efforts have been made to confine its ravages by countless miles of wire-netting. However, the rabbit is again becoming respected as the basis of a big felt and fur industry. The starling, which came to combat orchard pests, remained

FIG. 38. AUSTRALIAN ABORIGINALS OF THE NORTH-WEST

Primitive tribes still in the Stone Age, who have not advanced to the bow and arrow stage

to prey on the fruit. The blackberry brought by garden enthusiasts now threatens the farms and fern gullies of the south-east, while the cactus or 'prickly pear' claims half a million acres a year from the northern state. Even the camel, introduced for transport service in the dry lands, and the

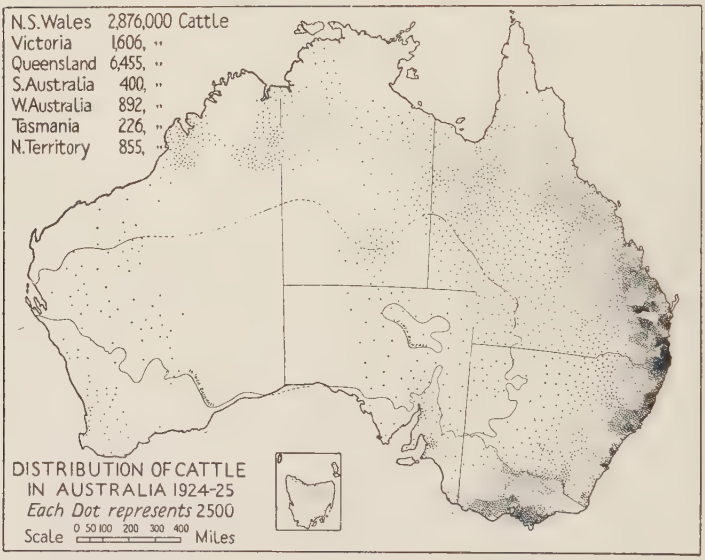

Fig. 39. DISTRIBUTION OF CATTLE

Indian buffalo taken to the north as a farm animal, have run wild.

Australia is, in general, far more dependent upon its animal than its vegetable crop. Sheep-breeding for the production of wool is the greatest single industry, although dairy-farming and cattle-raising are also of considerable importance. Here again the main control is that of rainfall. Although there is some overlapping, pasture begins where agriculture stops. Consequently the ten-inch rainfall line marks the boundary of the pastoral areas which are to be found in the great

interior plains. North of that, except on the Barkly Tableland, the sheep disappears, and is replaced by cattle which thrive in the hotter, moister conditions and on the harsher grasses of the north. Life on an Australian sheep station or cattle run is a lonely business. Since vegetation is sparse, each

FIG. 40. THE ECONOMIC BACKBONE OF AUSTRALIA

'Mustering' on a New South Wales sheep station. Note the character of the western plains

animal requires several acres, and vast areas are necessary for the 106 millions of sheep that are pastured. This represents one-sixth of the world's flocks. It will be easily realized that the pastoral population is widely scattered. Consider the population map for New South Wales, the state containing one half of Australia's sheep, and this fact of isolation will be further appreciated. The 'boundary rider' must cover hundreds of square miles in the performance of his duty; and, under the difficult conditions of an arid climate, he requires great skill and patience to keep the stock in good condition.

Droughts still mean enormous losses to the station owners of Australia, and affect the general prosperity very deeply.

Australian wool is mainly of the fine merino type, and buyers gather from all over the world to bid for that nine-tenths of the Australian clip that is exported. Wool sales are conducted in the season at the capital cities and also at Geelong and Launceston. The chief buyers represent Great Britain, United States, Japan, France, Belgium, Germany, and Russia. An increasing proportion of the clip is being used in local textile manufacture.

FIG. 41. ON A STOCK ROUTE, NORTH-WEST AUSTRALIA

In this arid country the 'overlanding' of cattle demands the greatest skill and judgement from the drovers, as the stages must be determined by the water and feed available. Note the typical clear sky

Although the cattle industry is not so important as that of sheep-raising, yet there are over thirteen millions of cattle in Australia which are the basis of the dairy-farming or meat industries. In the hotter and wetter conditions of the north, and in the areas with more than twenty inches of rain, roam the cattle that are the basis of the meat trade. The development of the export trade in butter led to a great expansion of dairy herds, and these are found mainly in a well watered temperate belt 100–200 miles wide along the east and south-east coast.

The conditions are in most places suitable for horse-raising,

which has declined somewhat from its former great importance owing to the competition of motor traction. Even for military services the demand is much less than formerly. The present number of horses in Australia is two-and-a-quarter millions. Closely connected with the development of dairying is the allied industry of pig-raising. About one million animals are maintained.

3. *Water-supply*

The dependence of the pastoral industry in central Australia upon supplies of water is very close, so close that the securing of water-supplies is the prime requisite for expansion. This water may be subterranean or on the surface, and reference has already been made to the storage and distribution of water in the drier parts of the south-east. A more remarkable system is that of the central plains and of other small basins where boring for subterranean water is carried on. These artesian bores will be examined more closely presently.

Irrigation is confined almost entirely to the south-east, or even more strictly still, to the Murray-Darling Basin, which is almost the only area with sufficient surplus water for irrigation purposes. The earlier schemes for using Murray waters were small and restricted in their scope, but the rights of people living farther down the valley were threatened by later schemes for storing the waters of the Murray and its tributaries. Further, the river forms a main highway, and the issue of 'Irrigation or Navigation' had to be faced. Ultimately a compromise was effected, by which the states concerned controlled the water in the general interest through the Murray River Commission. The locks were to be made navigable for river craft as far as Echuca.

The two great difficulties for irrigation to overcome were the irregular nature of the stream flow, and the delta-like character of the river with its many side-channels. In general, the supply of water is deficient for the demands likely to be

made on it; but against that has to be placed the undoubted fertility of the soil, which has been proved by irrigation colonies like Mildura and Renmark.

The other method of increasing water-supplies is by boring in the great artesian basin. This vast area receives, in general,

FIG. 42. ARTESIAN BORE IN CENTRAL QUEENSLAND

Notice the treeless character of the plains to which the motor-car is admirably adapted as a means of transport

less than ten inches of rain a year, and the sinking of bores to tap the subterranean waters has become an important part of development. It is to be noted that large variations occur both in the quality and quantity of the flow from these bores. Much of the water is so impregnated with mineral salts that it is useless for irrigation because of the alkaline deposits left on the surface by evaporation.

The artesian water-supplies of the great basin have become of prime importance to the cattle lands of Queensland, where

thirteen hundred flowing bores yield a daily supply of about 300 million gallons, in addition to many millions of gallons that are pumped to the surface by over 1,600 sub-artesian plants. The deepest bore attained a depth of over 7,000 feet. Other artesian basins have also been tested, and in the Murray Basin west of Hay many wells have been sunk but with varying success. One important result of artesian supplies has been to increase the carrying capacity of the land and to make small holdings possible. But present methods are wasteful, and action is now being taken to limit the flow to actual requirements because of the alarming decrease in the volume.

4. *Population and Settlement*

It can now be seen how rainfall control dominates settlement. If we exclude the artesian basins for the moment, we find that the main agricultural areas are determined by the factor of rainfall reliability as indicated in an earlier section. Applying this test of rainfall control, we find the chief industries of wheat-growing, sheep-raising, and dairy-farming all lying within the region of reliable rainfall. (The same control is again dominant in the cattle industry of the north, although the presence of artesian water tends to hide the control to some extent.) Now if the map showing distribution of population (Fig. 43) is examined it will be readily seen that the framework of settlement also has been laid out in a very definite fashion by the controls of climate and vegetation. The history of settlement shows, further, that as development proceeds, population tends to thicken rather than to spread. In Professor Taylor's words, the millions of the future will be settled precisely in the regions where the millions of to-day are found. The only exceptions to this rigid limitation of settlement are provided by the artesian areas already examined, in which no great density can ever be expected, and in the mining areas such as Broken Hill and Kalgoorlie, where the presence of rich mineral deposits has attracted settlement of a temporary nature.

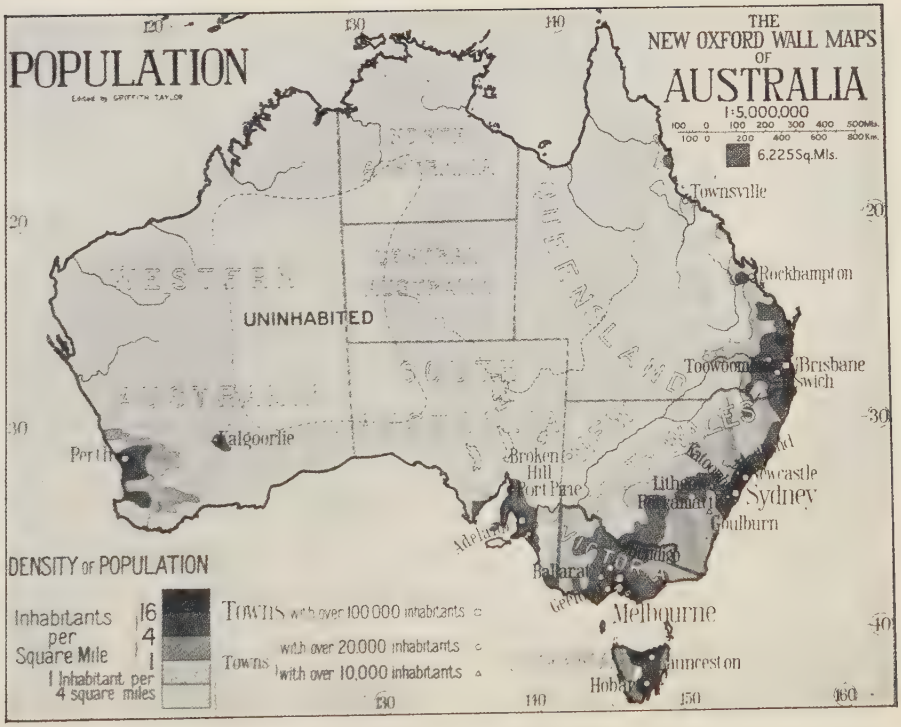

FIG. 43. DISTRIBUTION OF POPULATION

Two other aspects of Australian population may suitably be discussed here, viz. concentration and composition. Even if the population were scattered evenly over the surface, if that were possible, it would be spread very thinly, since each inhabitant would have about half a square mile. Although it has been shown that Australian prosperity is largely dependent upon rural industries, only about one-third of the people live in the country proper. The actual figures are these—in capital cities, 43 per cent.; in provincial towns, 25 per cent.; in country areas excluding towns, 32 per cent. Efforts are being made by assisted immigration to settle greater numbers of settlers in the wheat, fruit, and dairying areas; but the greatest single problem of settlement is presented by the empty north. While 300,000 people live in the coastal areas of tropical Queensland, not 30 are engaged in farming in northern Australia. This is due partly to climate, partly to lack of transport, but mostly to poor soils. The greatest possibilities seem to lie in the development of pastoral and mining industries.

The second aspect of composition bears to some extent on settlement. The people of Australia have decided that the mixture of different races, religions, and cultures presents problems that are better avoided, and permanent immigration is therefore limited to white races. Excluding the aboriginals, 99 per cent. of the population belongs to the white race, while over 95 per cent. is of British descent.

Chapter XIV

ECONOMIC SURVEY OF THE NORTH AND EAST

As settlement proceeded in Australia the continent was divided into colonies (since called states) by purely arbitrary lines that in no way coincide with the division into natural regions. Such artificial divisions are, in fact, a positive

hindrance to an accurate view of the facts of primary and secondary industry, and the boundaries between the states will therefore be disregarded. The major natural regions into which Australia falls have been discussed, and the re-

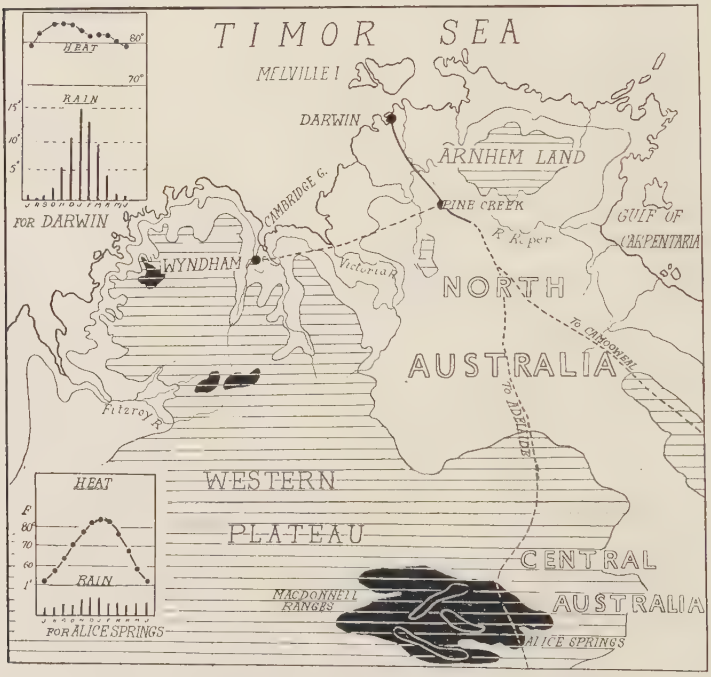

FIG. 44. NORTHERN AND CENTRAL AUSTRALIA
Contours for 500, 1,000, 2,000, and 3,000 ft.

mainder of our study will be an extension along the lines already laid down. We may conveniently distinguish the following areas: (1) North and Central Australia; (2) the Great Artesian Basin; (3) Coastal Queensland; (4) the 'Northern Rivers'—Darling Downs Region; (5) the South-east; (6) Tasmania; (7) the Murray-Darling Basin; (8) the South Australian Highlands and Rift Valley; (9) the West and South-west.

1. *North Australia and Central Australia*

These comprise the division formerly known as the Northern Territory. North Australia forms part of the tropical third of the continent, but must be distinguished sharply from coastal Queensland in the same latitude. Its development forms the most difficult problem facing the Australian people, since they have decided that settlement in the continent must be undertaken by members of the white race only. Climatically it is an extremely difficult region for Europeans; but a distinction must be drawn between the low-lying, mangrove-fringed coastal areas which offer the maximum of discomfort, and the more elevated interior. North Australia is not a region of steaming forest lands such as much of Malaysia. Less than 20 per cent. lying near the coast is of this type, while the higher interior is moderately moist, and for the greater part of the year has a healthier climate which the white settler finds at least bearable.

The area is, in general, a true pastoral region composed of great stretches of true savannah country. Sheep, except in the cooler Barkly Tableland, are unable to thrive under the monsoonal conditions causing ranker, harsher pasture; but the territory has become the main cattle region of the Commonwealth. Over the greater part of the area soils are poor, but extensive patches of great fertility exist, on which rice, cotton, tobacco, coco-nuts, fodder plants, and pea-nuts have been successfully grown. The great drawbacks for the development of tropical agriculture centre upon labour and transport. It has yet to be proved that the successful settlement of coastal Queensland by means of the sugar and pine-apple industries can be repeated under the less favourable conditions west of the Great Divide. Up to the present little progress has been made apart from cattle-raising and mining; but a more vigorous policy of development has now been undertaken by the Federal Government, the chief feature of

which is the completion of the North–South transcontinental line.

Native labour, by the assistance of which other tropical lands have been developed, cannot be counted upon in Australia. The aboriginals, of whom about 20,000 are estimated to live in the north and north-west, are nomadic tribes engaged mainly in hunting. They know nothing of agriculture, and are unable to adapt themselves to any settled occupation. A comparative few, however, are employed in connexion with the cattle industry under white supervision. The comparative absence of tropical diseases of the malarial type makes the position more hopeful than it would otherwise be for white settlement. About 3,000 whites are engaged in the cattle industry and government services, while 1,500 Asiatics are employed in mining for gold and tin, in trading, and in pearl-fishing.

The conditions accompanying climatic changes in northern Australia are important in comprehending the settlement problems of the region, and the following description will be useful:

'The different changes of the seasons are so uniform and regular that they may be predicted almost to a day. Signs of the approach of the wet season appear in September, when the strong ESE. monsoon—which has been blowing continually throughout the dry season—ceases, and is succeeded by calms, and light, variable winds; the weather becomes intensely hot, and small thunder-clouds gather over the land, increasing in size and density day by day until they burst into terrific thunderstorms, accompanied by hurricane squalls of wind and rain. These squalls increase until the end of November, when they occur almost daily. They come up in a dense black bank, and travel so very rapidly that they are generally out of sight on the western horizon within 40 minutes.

'During December the NW. monsoon gradually gains the ascendancy. The thunderstorms disappear, the sky becomes overcast and clouded, and the atmosphere gets thoroughly saturated with moisture—so much so that leather-work becomes green with mildew if not constantly attended to; the binding of books becomes

soft; and sugar or salt, if exposed in an open vessel, will soon liquefy. Even this is felt to be an agreeable change after the intensely hot weather during the change of the monsoon in October and November.

'The NW. monsoon is accompanied by rain almost daily, and increases in force until the latter end of January or beginning of February, and penetrates with its copious and fertilizing showers into the very centre of Australia. The maximum temperature in the shade during the day in this weather is 96°, and the minimum during the night 65°.

'On the approach of the autumn equinox the NW. monsoon gradually dies away, and is succeeded by calms, variable winds, thunderstorms, and oppressive weather until the end of April, when cooler weather is felt; the SE. monsoon sets in, and the dry season may be said to have fairly commenced. The wind is characterized by a clear sky, enjoyable weather, heavy dews, and cold mornings and nights—so cold that blankets can be used. It blows off the coast without intermission, and with great force, almost throughout the season, being in full heat between June and July.'[1]

The southern half of 'the Territory' now constitutes for purposes of administration the division of Central Australia. The conditions become more arid and difficult so far inland, but a promising area for pastoral development exists in the MacDonnell and Musgrave Ranges with more reliable though still scanty rainfall.

Darwin is the administrative centre of North Australia, but its progress as a port is slow owing to the undeveloped hinterland and the infrequent steamer services. It is the point of connexion between the cable and the overland telegraph. *Wyndham* farther to the west is more favourably situated with regard to the great pastoral belt and will doubtless become the centre for the meat industry. *Alice Springs* in 'Centralia' is to be the head-quarters for the central state.

[1] Adapted from a description quoted by Professor Griffith Taylor in *The Australian Environment.*

2. *The Great Artesian Basin*

This region varies greatly in both rainfall and fertility. The eastern half with the better soils carries that alternating

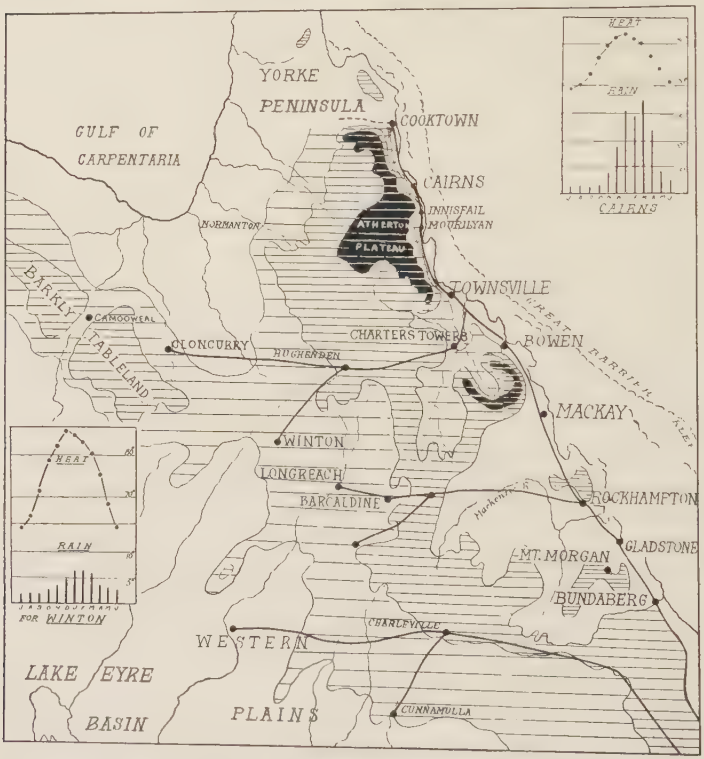

FIG. 45. THE GREAT ARTESIAN BASIN AND CENTRAL QUEENSLAND. Contours for 500, 1,000, and 2,000 ft.

grass and bush-land that marks the ideal cattle country. This characteristic vegetation shades off in the south-west towards Lake Eyre, where conditions are so dry as to support only comparatively few cattle. This great basin is one of the

most extensive areas of inland drainage in the world. Lying nearly 100 feet below sea-level, it is a vast, salt-encrusted mud flat, holding a few inches of water only after heavy rains. The neighbouring Lake Torrens stretching for 150 miles to the south is a similar area. The brigalow, a species of acacia, is characteristic of large stretches of the inland plains. Gums occur most thickly along the eastern divide and in the water-courses. An outlier of the western plateau—Barkly Tableland—lies along to the south of the Gulf of Carpentaria, and is the most promising area for pastoral development in the region. North of this the land slopes away gradually to the mangrove swamps fringing the shallow Gulf. One of the problems of the region is the difficulty of access from the north, only one port—*Normanton*—presenting any possibilities.

Much of what has been said concerning North Australia applies also to this region. Allowing for tapering rainfall towards the interior, seasonal changes are very similar; but the range of temperature is greater inland. Only the presence of the artesian water, which has been discussed elsewhere, makes it possible for the cattle stations to carry their stock through the long dry spell.

Communications have developed by means of railways from the eastern ports to the pastoral interior. The most northerly of these runs from Townsville across the ranges to *Hughenden*, an important pastoral centre. The line continues thence to *Cloncurry* a copper-mining area on the edge of the Barkly Tableland. Other lines run back from Rockhampton to *Longreach*, and from Brisbane through the Darling Downs to *Quilpe* almost on the edge of the Lake Eyre Basin. An important project is to link up the eastern states to Darwin by a line from Bourke in New South Wales via Camooweal. The great inland areas in this region receiving 15 and more inches of rain a year are largely responsible for the prosperity of Queensland.

3. *Coastal Queensland*

The main feature of this region is the narrow strip of country between the highlands and the Pacific. The highest land of the divide rises almost abruptly from the sea. This is the Bellenden Ker Range, the coastal battlement of the Atherton Plateau in which the highest peak, Mount Bartle Frere, rises to nearly 5,500 feet. Opposing as it does the prevailing trade-winds, it is not surprising to find that the highest rainfall in Australia occurs hereabouts. A very large area receives over 50 inches of rain a year, while some localities receive over 160 inches. This led Professor Griffith Taylor to regard it as 'the most favourable region for close white settlement in northern Australia', a prophecy which has been fulfilled in a remarkable manner since it was first made. The height of land in general lies much farther back from the coast than this, however, and the divide behind Rockhampton is 300 miles from the sea. The highland region is a broad belt of range country which narrows to the north and south, but makes communication between the seaboard and the interior a matter of some difficulty.

In the wetter uplands dairying has become an important industry, although some parts are little more than 1,000 miles south of the equator. The great staple of the region is sugar; and, as rainfall is sufficient everywhere along the coastal ribbon, each river valley has become a cane-growing area. A feature of its development in the last few decades has been the influx of Italian settlers to the more tropical lands of the far north between Mackay and Cairns. These two industries, together with mining, are the main support of the 300,000 whites who live in the coastal belt north of the Tropic. This constitutes the most successful attempt at tropical settlement by the white race in the world. In addition to sugar-growing, the cultivation of bananas has become an industry of some importance. *Mackay* is the chief centre for sugar-refining

and export, but *Bundaberg* and *Maryborough* are also of consequence in this industry. The broad Fitzroy Valley, a splendid grazing area, opens out to *Rockhampton* on the coast, the chief port and commercial city of central Queensland. An important irrigation scheme is planned for the Dawson Valley which opens into the Fitzroy about 60 miles inland.

FIG. 46. THE WHITE MAN IN THE TROPICS

Cane-cutting in Queensland. The Australian sugar industry is the basis of the greatest experiment in colonization of the Tropics by whites that the world has seen

The highland region has always been noted for its rich mineral deposits, although its former great production of gold and copper has declined of recent years. The glory of Mount Morgan has departed, but very prolific fields exist elsewhere. Behind Cairns is the Chillagoe field noted for its tin and copper. *Townsville* is the outlet for the important gold-mining area around *Charters Towers*, while *Maryborough* is the port for other mining areas around *Gympie*. Coal of

good quality is worked at *Ipswich*, *Wide Bay*, *Rockhampton*, and *Bowen*. The total output, however, is only one-tenth of that of the Hunter River Valley. This mountain region is also important for the possibilities it offers for the production of hydro-electric power from the vigorous rivers all along the seaboard.

4. *Darling Downs—'North Coast Rivers' Region*

This region is in many respects a southern continuation of the two divisions just described. The main divide curves towards the ocean from the Buckland Tableland, 300 miles inland from Maryborough, to within 20 miles of the coast in the New England Plateau, enclosing in this sweep the Darling Downs. The New England Plateau is the largest mountain block in Australia, and although it is not the highest it rises to 5,000 feet in Ben Lomond. As in north Queensland, where the highlands stand close to the ocean heavy coastal rainfall is the rule. Most of the region enjoys more than 10 inches, and the whole of the coastal belt receives from 40 to 60 inches. The well watered uplands are notable for extensive forests of gums and softwoods, which thin out towards the plains. The drier conditions to the west are responsible for the concentration on sheep-raising as the main industry. Between the plains and the plateau, however, is a considerable area of foot-hills devoted to mixed farming. The coastal strip passes from the sugar belt which ends about Grafton into the splendid dairy-farming country lying in the valleys of the 'North Coast Rivers', as they are called.

Although not usually included in this group of rivers the Brisbane is the most important, since it has become the southern gateway of Queensland and the entrance to the metropolis of the State. *Brisbane* (300,000) lies a little inland from the coast, and the river fairway is maintained by dredging. By situation the city commands the route through Ipswich, a coal-mining area, to the very productive Darling

Downs district. The chief inland centre is *Toowoomba*, the capital of the Downs country, with nearly 25,000 people. Farther south of the Brisbane, the Tweed, Richmond, Clarence, and Macleay rivers have scooped from the plateau the valleys that form the chief areas of production. Sugar-cane growing has largely given place to dairy-farming, although *Grafton*

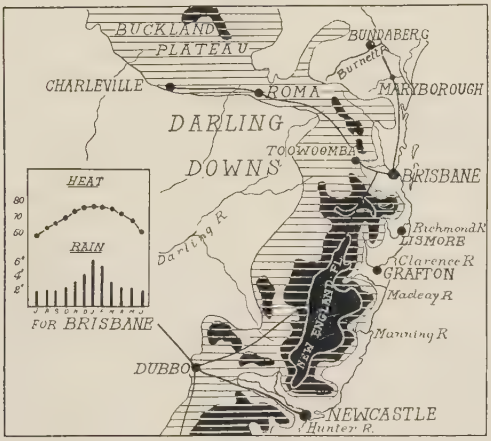

FIG. 47. EAST COAST OF AUSTRALIA
Contours for 1,000, 2,000, and 3,000 ft.

still owes its importance largely to sugar. Bananas have also become an important commercial crop in this district. *Lismore* is another thriving commercial centre on the coastal belt. It is worth noticing that the main railway to the north climbs to the plateau nearly 3,000 feet above the sea to pass through *Tamworth*, *Armidale*, *Tenterfield*, and *Warwick*, all, except Tenterfield, which is engaged in tin-working, being farming centres of 5,000–7,000 people.

At the extreme south of this region occurs the wide fertile valley carved out from the surrounding plateaux by the Hunter River. At the back of the valley is the pass that forms one of the most important gateways to the Pacific, the Cassilis

Gate, opening on the great pastoral areas of the interior. The valley itself is the seat of many successful primary industries, from dairy-farming to vine-growing, and from saw-milling to cotton-raising, all of which depend upon the rich volcanic soils resulting from the basalt flows of past ages.

FIG. 48. THE PACIFIC WALL IN EASTERN AUSTRALIA

The Great Divide and eucalypt forests from the Tweed Valley, with Mt. Warning in the distance

The Hunter Valley has, however, become of the greatest economic importance for other reasons than these. From 12 to 30 million years ago great forests in this area were submerged and buried under masses of silt carried down to the sea-bed, and became in time the highly important coal-measures of the district. These occur in three great series, the Upper or Newcastle, the Middle or East Maitland, and the Lower or Greta coal measures. Of these the last is now the most important, since Greta or Maitland coal is the best

for gas-making and fuelling purposes. Nearly two-thirds of the immediately workable reserves of Australian coal lie in this valley, and the whole of Australia is dependent in a greater or less degree on the area. Oversea export, which was previously very important, has declined in recent years. *Newcastle* at the seaward end of the valley has thus become a very busy coal port, and the centre for heavy industries dependent on coal such as the making of steel, galvanized iron, and wire, shipbuilding and engineering, and the making of cement. Dense centres of mining population occur up the valley, especially at *Cessnock* on the South Maitland field.

Chapter XV

ECONOMIC SURVEY OF THE SOUTH-EAST AND SOUTH-WEST

1. *The South-East*

This region is formed by the highland masses of the eastern system and the coastal area of varying width between them and the sea. This mountain section is, in general, less wide than it becomes farther to the north; and it falls into a series of massive blocks of which the Blue Mountains and the Kosciusko Plateau are the most notable. These masses are separated by depressions that form the gateways from the coast to the interior. The Blue Mountain Plateau, a great, hard, sandstone block, falls away sharply on the seaward face; and is dissected by the coastal rivers into the series of remarkable canyons and gorges that are features of the rugged scenery in this region. Between this block and the complex south-eastern 'knot', at an elevation of 2,000 feet, occurs the important Lake George Gap through which the main route to the south-west taken by the Sydney–Melbourne Railway passes. South of this gateway are three blocks separated by

deep gorges and culminating in summits that are the highest in Australia, viz. Kosciusko (over 7,000 feet), Bogong, Feathertop, and Hotham (all over 6,000 feet). Connecting the gorges of the Tabmo and Mitta Rivers is the Omeo Gap lying at an elevation of 3,000 feet. This great region of 'humps' is known as the Australian Alps, yet they are

FIG. 49. SOUTH-EAST AUSTRALIA
Contours for 1,000, 2,000, and 3,000 ft.

not truly Alpine in character, despite the almost perpetual snow fields and bare rock-faces. Although the ravages of fire and axe are rapidly diminishing their importance, some of the finest forest areas occur in this corner. Westward of the Alps the Cordillera diminishes in mass and falls away to the Kilmore Gap north of Melbourne, the main gateway from the south, lying at an elevation of 1,200 feet. Westward again the ranges rise to heights of 2,000 feet in the summits of the Pyrenees and the Grampians. Towards Cape Otway and

Wilson's Promontory there are other highland regions that mark the southern edge of the east–west valley of Victoria which is bisected by Port Phillip.

The district between the Blue Mountains and the sea is somewhat barren because of the control exercised by the characteristic sand-stone. Beneath this area lies the saucer-like formation of the coal measures, reaching the surface in a wide sweep from Newcastle to Moss Vale, and from Bathurst to Bondi. Farther to the south better soils and good rainfall are the factors responsible for the main industry of dairying. The great valley of Victoria consists of the district of Gippsland, widely varying in fertility, and the western district which has been rendered extremely fertile by the soils resulting from the great basalt flows of ancient times. Both east and west of Port Phillip the valley is the seat of important rural industries such as dairying, sheep-raising, fruit-growing, and agriculture of many kinds from wheat to maize, and from beans to sugar-beet. *Maffra* is the centre for beet growing, *Orbost* for maize and beans.

FIG. 50. EUCALYPT FOREST, SOUTH-EAST AUSTRALIA

Although Australia is deficient in pines, the finest hardwood forests in the world are found in the coastal areas

Owing to the temperate climate and the great productivity of the south-east, most of the population is concentrated in

this coastal area. *Sydney*, a city of over a million people, is notable as the main outlet for the produce of New South Wales. It became important in the first place as the centre of administration, and was later consolidated by the convergence of railway lines from north, south, and west on the port. Almost the whole of Australia's trade in the

FIG. 51. THE ROOF OF AUSTRALIA

Valley of the Upper Murray with the snow-covered Kosciusko Plateau in the distance. Typical dairy-farming country

Pacific is concentrated at Sydney, and important connexions are being developed with every country facing that ocean. Excepting *Goulburn*, an important railway town on the plateau, a number of small coastal towns such as *Kiama*, *Bega*, and *Eden* are the chief centres of settlement until we cross into Victoria. Here *Sale* and *Bairnsdale* are the two prosperous rivals of east and west Gippsland, lying in rich agricultural districts. Most of Gippsland is a recently raised portion of the sea-bed lying in a belt about forty miles wide over which alluvial silt has been spread by the coastal rivers. The present

coast is a line of sand-dunes behind which the old estuary has been enclosed as a series of lakes or lagoons which are being slowly filled with silt brought down by the rivers. In contrast to the recently submerged coast of New South Wales round the Cape Howe corner, the Gippsland coast is deficient in

FIG. 52. BROWN COAL DEPOSIT, YALLOURN

Yallourn, a composite aboriginal word, means 'brown fire'. The picture shows the beginning made in 1920 to work the deposits. Note the lighter 'overburden' about 50 feet thick and the darker coal into which the cut is being made. The deposits contain sufficient coal to generate one million horse-power daily for 400 years

good harbours. The lakes have become the seat of an important fishing industry supplying the Melbourne market.

An industry of great importance to the State of Victoria has developed at *Yallourn*. The most extensive lignite beds known to exist occur here, and the 'brown coal' is used for the generation of electricity, which is transmitted all over the State and across the Murray into New South Wales. Apart from its interest as a Government enterprise, with its own

complete town, it is remarkable as an attempt to supply power and light to a whole state from a central generating station.

Port Phillip is a drowned portion of the lower valley and flood plain of the Yarra, and is notable as a sheltered seaway into the very heart of the great valley as far as the present

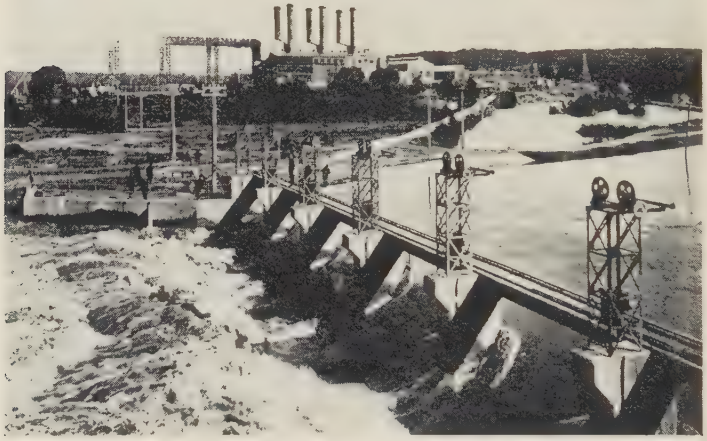

FIG. 53. YALLOURN ELECTRICAL SCHEME

The Power House and Transmission Station, which supplies Melbourne, 110 miles away, with power, light, and heat

Yarra estuary. At its head stands *Melbourne* commanding in a remarkable manner the converging routes east–west along the valley and north–south through the Kilmore Gap. It has thus by a natural development become the central port for the trade of the valley and of the fertile Murray Basin across the highlands. It has become, also, a great industrial centre containing over a million people.

West of Port Phillip lies the remainder of the great valley, immense areas of which have been flooded by basalt in the

past. Many extinct volcanoes rise from the surface of this plain, while the blocking of valleys and depressions by the lava-sheet has resulted in the formation of many lakes. In parts of the area, e.g. Warrnambool and Mount Gambier, the decomposed basalt and volcanic ash have formed soils of wonderful fertility, while in others the erupted rock has resulted in barren areas suitable only for grazing. *Geelong* on a western arm of Port Phillip, and *Portland* on the ocean in the south-west, are the natural outlets for this very productive area, which goes by the name of the Western District. Geelong is, in addition, a rapidly developing centre for woollen manufactures. *Hamilton* is the chief inland town of the region. The Otway ranges are rugged, well watered areas fronting the Southern Ocean, and presenting great possibilities for afforestation.

The highlands to the north of this valley are old sedimentary masses thrust through by granite and in places flooded by lava. After 1850 this plateau region became the scene of great gold-mining activity, and important mining centres such as *Ballarat*, *Bendigo*, and *Castlemaine* developed. With the decline of gold production these towns have had to turn to other industries connected with the agricultural and pastoral resources of the area.

2. *Tasmania*

The island state of the Commonwealth is geographically a southern extension of the eastern highlands cut off by the drowning of Bass Strait. The consequent isolation, like that of Australia, has had the effect of preserving types of animal and plant life that represent even earlier forms than those of the mainland. The most interesting of these were the aborigines who form a most important link in the story of man's development. They failed to survive the contact with the white man, and the last of them died in 1877, unfortunately before adequate study had been made of their habits and customs.

The chief features of the island's structure are (i) the heavily forested *peneplain area* of the west and south-west dissected by the deep gorges of the rivers; (ii) the *Central Plateau* of about 2,000 feet average elevation consisting of old sedimentary rock capped by a great lava flow, and studded with comparatively shallow lakes lying in depressions in this

Fig. 54. TASMANIA

lava sheet; (iii) the smaller, similar, and higher *North-eastern Plateau*, rising to the 5,000-feet summit of Ben Lomond; and (iv) the *East Coast Highlands*. Lying between these massive blocks are the South Esk, Macquarie, Derwent, and Huon river valleys, which form the main drainage systems. The lowering of the whole area, at the time when Bass Strait was formed, led to the drowning of the estuaries and the formation of the inlets, properly called *rias*, such as the Tamar estuary, Macquarie Harbour, and D'Entrecasteaux Channel, which mark the whole coast-line.

Climatically Tasmania forms a distinct region, lying, as it does, so far to the south that it comes under the influence of the Westerlies for the greater part of the year. Generally speaking, the climate is therefore cooler but more uniform than that of south-east Australia, to which it bears a close resemblance in many ways. The westerly direction of the prevailing winds results in the characteristic 'wet and dry side' effect: the west coast receives upwards of 100 inches of rain a year, while areas in the lee of the central plateau and on the east coast receive an average of only 10 inches. One notable result is the very definite control of forest growth exercised by the rainfall. A feature of the vegetation of the island is the contrast between the dense beech and eucalypt forests of the areas within the 60-inch rainfall line, and the more open country of the east and centre.

FIG. 55. RUGGED WEST COAST, TASMANIA

The canyon, 3,000 feet in depth, gouged out by the King River. The rainfall in this area approximates 100 inches a year and accounts for the jungle-like forest

Along the north side extensive basalt flows have occurred, and the decomposition of these has resulted in the rich 'chocolate' soils of the north-west and north-east which form the basis of the island's agriculture. Dairy-farming and potato-growing are the main industries in these areas, contrasting with the sheep-raising of the drier 'midlands' and

eastern districts. The Derwent, Huon, Tamar, and Mersey Valleys are important for the development of fruit-growing as the main industry. The climate and soil conditions are most suitable for pip- and stone-fruits, so the cultivation of apples, pears, and apricots for a growing export trade to

FIG. 56. APPLE-GROWING, SOUTHERN TASMANIA
Typical orchard country

Britain and Europe has consequently become a staple industry of the island. The Derwent Valley is the chief centre for the production of hops in Australia.

The extensive forests have long been the seat of important saw-milling industries, particularly in the Huon Valley, where one of the finest eucalypt forests in the Commonwealth formerly existed. This industry has declined in importance recently, but later developments connected with the establishment of paper-pulp and artificial silk manufacture may awaken greater interest in what may yet prove the state's greatest

asset—its timber-growing possibilities. Extensive schemes for the planting of trees yielding softwoods are being developed.

The ancient rocks of the west and south-west are extremely rich in minerals. Almost every known mineral occurs somewhere on the west side, but the silver-lead-zinc of the Mount

FIG. 57. GREAT PIPE LINE AND POWER STATION, WADDAMANA

Water from the Great Lake on the Central Plateau is plunged down this 1,500 feet slope to the power house, and the current generated is transmitted to Hobart 60 miles distant

Read-Rosebery district, and the copper ores of Mount Lyell are the most important. The tin deposits of Mount Bischoff are now almost exhausted, but mining for this metal is carried on extensively through the granite country of the north-east. Coal is found in many places in the island, but except at Catamaran in the south-east the seams are thin or the coal of poor quality.

The comparative poverty of the coal areas, however, has not

proved a great deterrent to the island's industry because of the natural advantages it possesses for the generation of hydro-electricity. The lakes of the central plateau, the drainage from which falls from 1,800 feet to sea-level within 50 miles of the plateau, provide ideal conditions for this purpose.

FIG. 58. ELECTROLYTIC ZINC WORKS, RISDON

An industry dependent upon the hydro-electric power from the Great Lake scheme and producing a hundred tons of pure zinc daily

The waters of the Great Lake are led by canal and pipe lines to *Waddamana* in the Ouse Valley, and the energy there developed is transmitted to Hobart, 60 miles away, where the power is used in several important industries of which the electrolytic zinc works at *Risdon* are the most noteworthy. Another scheme supplies the northern side of the island, while a third is in operation for the metallurgical industries at *Queenstown* on the west coast.

Hobart on the Derwent estuary commands a number of excellent water routes to the timber and fruit districts of the

south-east and has become the chief oversea port for the state. A number of industries relying on hydro-electric power have been established in recent years. The east and south-east coasts are very rich in fish life, and the fishing industry in this area is bound to become more important in the future. *Launceston*, lying 40 miles inland at the head of the tidal waters of the Tamar, is the chief port and commercial centre for the north, relying chiefly on the rural industries in the north of the island. Natural climatic advantages for woollen manufacture have led to the establishment of several mills. *Devonport* is the outlet for the rich agricultural Mersey Valley and the 'chocolate' soil country of the region. *Burnie* has become the chief gateway to the west-coast mining areas since the entrance to *Strahan* on Macquarie Harbour is rather difficult. *Scottsdale* is the centre of the fertile north-eastern agricultural and dairy-farming area.

3. *The Murray–Darling Basin*

The great basin of the Murray and its tributaries lies mainly within the south-eastern elbow of the Great Divide which forms the main catchment for the streams of the system. In many respects it constitutes one of the most important regions of Australia on account of the great agricultural and pastoral industries carried on in the area. Generally speaking, it falls into three distinct divisions: (i) the *wheat belt*, lying nearest the highlands in Victoria and New South Wales, which merges in the upper valleys into a mixed farming area where dairying has become of considerable importance. The inner margin of the belt passes into the Mallee country, where the greatest extension of wheat-growing has taken place in recent years although the rainfall rarely exceeds 10–15 inches. Modern methods of dry-farming and the use of fertilizers have considerably enhanced the value of the Mallee areas, which until quite recent times were regarded as almost worthless. A very important and extensive scheme of open channels,

by which water for stock is brought from Lake Lonsdale for a distance of 250 miles, has been responsible for a considerable increase of sheep in the area where they are pastured on the fallows. (ii) The drier *grazing area* which occupies the remainder of the basin, or about half the area of New South

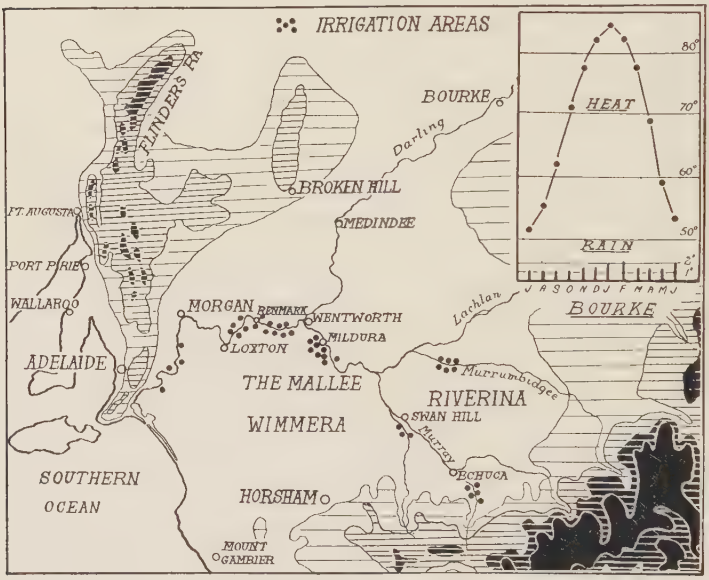

FIG. 59. THE MURRAY VALLEY

Contours for 1,000, 2,000, 3,000, and 4,000 ft.

Wales. Considerable overlapping of the sheep and wheat belts occurs towards the eastern highlands, but nearly half of Australia's one hundred millions of sheep are pastured in the basin, which constitutes the world's most important area of wool production. The highly fertile Riverina district lying between the Murray and the Murrumbidgee calls for particular mention in connexion with both wheat and wool production. The chief centre for this area is *Hay*. (iii) The

irrigation areas which have been developed in the basin, especially along the lower Murray and the tributary streams of the Murrumbidgee and the Goulburn. The main difficulty of irrigating the valley arises from the fluctuations in the volume of the water carried down by the rivers of the system. The variation is so great that a commission representing the Governments of the three states concerned and the Commonwealth has been formed to co-ordinate the development of the Murray Valley. The first problem was that of storing the waters to provide an adequate flow for both irrigation and navigation during the dry summer. The greatest project is that of the Hume reservoir, which is designed to control the waters of the upper Murray by means of an immense storage basin with a surface area three times as great as that of Sydney Harbour. Another scheme of a different nature is devised to regulate the lower Murray by a series of locks and weirs placed at intervals along the stream. Of the twenty-six planned over one-half had already been completed by 1930.

FIG. 60. IRRIGATION IN THE MURRAY VALLEY

The key to the system is the Dethridge meter which measures the water used by the settlers on each block. The farmer declares that it irritates rather than irrigates

Apart from these major schemes under the control of the River Murray Commission, each state has completed important irrigation works. The Murrumbidgee Irrigation Area is supplied from the Burrinjuck Dam 200 miles farther up stream, and has become one of the most important fruit-growing and dairy-farming districts in New South Wales. There are several irrigation schemes on the Victorian side,

the most important of which is that of the Goulburn Valley, which has increased the productivity of the region enormously. The waters of the Loddon are used in a similar way, but the scheme is not nearly so extensive. The network of open channels by which the Mallee and Wimmera areas are provided with stock and domestic water from Lake Lonsdale some 250 miles distant is a wonderful engineering triumph. At Mildura in Victoria smaller areas are irrigated on a more concentrated plan for the production of citrus and vine fruits.

The South Australian portion of the Murray is a fine waterway for over 300 miles, and great use of the river is made for irrigation purposes. Large pumping plants have been installed, and between Morgan and the Victorian border a number of very important fruit-growing areas have been established of which those at *Renmark*, *Berri*, *Cobdogla*, and *Waikerie* are the most important. Still farther down the river the swampy flood-plain has been drained and dairy-farming has become an important industry.

These are merely the main irrigation areas, and many others are operating along the valley on a smaller scale. The extension of fruit-growing in these districts now depends not upon water-supply but upon the securing of adequate markets for the increasing output.

An unsatisfactory feature of the region is the character of the Murray mouth. The river discharges into Lake Alexandrina, a great lagoon; and the waters reach the ocean through a break in the dune coast-line. For navigation purposes the entrance is useless, and this is a serious handicap to the economic development of the lower Murray Valley. To overcome it will entail very costly construction of either a canal or a railway to a suitable port on the coast.

4. *The South Australian Highlands and Rift Valley*

The highland system which causes the Murray to make an abrupt right-angled bend to the southward extends away to

FIG. 61. WOOL BARGES ON THE MURRAY

This illustrates what the presence of a seaport at the Murray mouth would mean to the valley

FIG. 62. CARTING WOOL TO THE RAILWAY, SOUTH AUSTRALIA

'And thus—'tis a thankless life at best!—
Is Distance fought in the mighty west,
And the lonely battle won.' (LAWSON)

the north for 300 miles as the Mount Lofty and Flinders Ranges. These highlands rise towards the north, where peaks of over 3,000 feet are situated, but in general they have an altitude of about 2,000 feet. This is sufficient, however, to give even the drier north a higher rainfall than the adjacent plains. The hill slopes are consequently areas of cultivation; and fruit-growing, from the grape to the apple, and from the almond to the olive, has become a staple industry. An important subsidiary industry is wine-making, and the greater part of the Australian vintage comes from this region.

From early days this area has been noted for copper production, and famous mines existed at *Burra*, *Kapunda*, and *Moonta*. The industry has declined of late years and the great mines are now all idle.

Between the South Australian highlands on the east and the south-western corner of the Great Plateau lies a vast north–south depression known as the Rift Valley, partly drowned by the two large gulfs of Spencer and St. Vincent. This plain country forms the most productive part of the state of South Australia. In the south, where the rainfall is above 10 inches, the plains form part of the wheat belt, which merges to the north into the pastoral belt. *Adelaide*, a city of 330,000 people, stands on this plain at the foot of the Mount Lofty Ranges and at a distance of about 6 miles from the Gulf of St. Vincent. It is favourably situated as a centre for collecting the products of both the valley and the highlands. The disadvantages of the long and expensive haul over the Lofty Ranges and the dearth of a good harbour have been successfully overcome; and many important manufactures have developed, chiefly at *Port Adelaide* on a navigable arm of the Gulf. *Wallaroo* occupies a somewhat similar position on Spencer Gulf. Once associated with the copper industry, it has now become a prominent wheat-port. *Port Pirie*, farther to the north, is a busy industrial centre dependent upon the mines of Broken Hill. The products of its silver-

lead-zinc smelting, and the wheat and wool from the northern plains are the chief export commodities. Across the gulf lies *Whyalla*. The iron ores from Iron Knob are sent from here to the steel-works of Newcastle. *Port Augusta* has an important situation at the head of Spencer Gulf, where the main

FIG. 63. THE MODERN PIONEER

Converting bush to wheatlands in Western Australia. Blasting trees preparatory to burning

east–west route rounds the inlet. The building of the east–west railway to Kalgoorlie enhanced its importance as an outlet for the northern end of the valley, and it will be the terminus of the north–south line now being completed beyond Oodnadatta to Darwin. An industry of some importance is the recovery of salt from the shallow salt-pans of Yorke Peninsula.

5. *Western Australia*

The settled portion of the great western state consists merely of the south-western corner of the Great Plateau, a fertile

region that enjoys the most reliable rainfall in the continent. The greater portion of the State, approximately one-third of the area of Australia, is thus comparatively uninhabited. Much of what has been said previously concerning northern Australia applies also to the tropical north of this State.

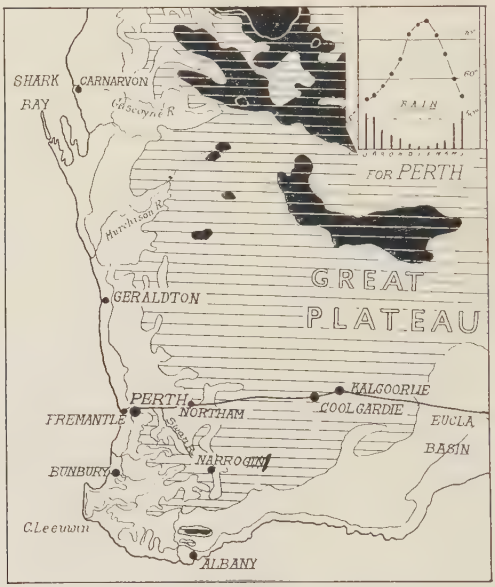

FIG. 64. WESTERN AUSTRALIA
Contours for 1,000, 2,000, and 3,000 ft.

A very definite thinning out of the vegetation, due to diminishing rainfall away from the coast, is the main feature of the area. Thus in passing from the south-west corner towards the centre of the plateau, the zones of vegetation are as follows: (i) the wettest south-west corner with splendid karri forests; (ii) the jarrah forests shading off into (iii) the drought resistant eucalypts of the Mallee type; (iv) the still drier region characterized by Mulga scrub—a species of

acacia; (v) the salt-bush of the semi-desert; and finally (vi) the desert proper.

The economic development of the region consequently falls into zones that are just as definite as the vegetation belts. In the true mediterranean region of the south-west fruit-growing, dairy-farming, and timber-cutting are the main industries. The timbers from this area, karri and jarrah, are

FIG. 65. THE PEARLING INDUSTRY

Pearling luggers in north-west Australia

of the greatest value on account of their durability and resistance to the termite or 'white ant'. Behind this area lies a belt where wheat-growing has been greatly developed in recent years. Western Australia has already caught and passed the eastern states in wheat production, and even greater development may be expected until the areas within the 10-inch rainfall line are all under settlement. Between the wheat belt and the desert proper lies an extensive pastoral area which is also capable of being utilized to a greater extent than at present.

The southern edge of the plateau is remarkable for other

reasons than that of agricultural or pastoral development. Here the rainfall is scanty and unreliable, but the presence of gold-bearing reefs led, after 1890, to a 'gold rush' that resulted in the establishment of big mining centres such as *Coolgardie*, *Southern Cross*, *Boulder City*, and *Kalgoorlie*. But the 'Golden Mile' and similar areas are now almost deserted. *Kalgoorlie*, the last of the giants which still precariously maintains the industry, has two features worthy of notice, viz. the great pipe line, 250 miles in length, which brings the water-supply from the coastal belt, and the change over or 'break of gauge' between the Western Australian and Trans-continental railway systems. The great desolate area of the Nullarbor Plains with their characteristic salt- and blue-bush lies still farther to the west. To the north-west is a great corner too hopelessly arid for any use to be found for it except round the limited artesian basin.

BIBLIOGRAPHY TO PART III

Official Year Book of the Commonwealth of Australia.

Taylor, Griffith. *Geography and Australian National Problems*, A.A.A.S. Proceedings, 1923.

The Australian Environment, 1918. Memoir No. 1 for the Advisory Council of Science and Industry.

Australia, Physiographic and Economic, 1919. (Clarendon Press.)

(Contributed.) *Australia*, pp. 1–374, in vol. v, Oxford Survey of the British Empire. (Clarendon Press.)

B.A.A.S. Handbook to Australia, 1914. (Govt. Printer, Melbourne.)

Phillips and Wood (Edit.). *The Peopling of Australia.* (Melbourne University Press.)

Wood, G. L. *The Tasmanian Environment*, 1929. (Robertson and Mullens.)

PART IV

NEW ZEALAND

Chapter XVI

PHYSICAL AND CLIMATIC

1. *Structure and Surface*

Whether we regard it from the aspects of structure, position, plant and animal life, or human types, the Pacific Basin contains no more interesting group than the islands comprising the Dominion of New Zealand. Its isolation to the south of the great ocean appears to be complete, and even an examination of the ocean floor reveals no very intimate connexion with any of the continental land-masses. To the west a vast basin—the Thompson Trough, 700 miles wide and 15,000 feet in depth—separates the group from Australia; while, on the east, the land drops steeply to another deep depression. Ocean soundings have, however, revealed the presence of two long submarine ridges stretching out like the prongs of a fork, and continuing the main lines of the surface features far to the north. One of these runs clear from the mountain chain of the South Island, through the ranges to the east of the North Island and away under the sea to reappear in the peaks of Kermadec, Tonga, Fiji, and Samoa. For the greater part of its length this ridge is less than 5,000 feet below the surface; and, on its east side, it falls sheer into the immense abyss of the Aldrich Deep, where the soundings of 30,000 feet have only been exceeded in the famous Tuscarora Deep to the east of Japan. The second ridge maintains roughly the direction of the Auckland Peninsula, and runs in parallel lines as far to the north as New Caledonia. The three main islands are thus merely an

FIG. 66. NEW ZEALAND, PHYSICAL

unsubmerged fragment of a great system of folds that rises steeply from the ocean floor, and is broken by Cook and Foveaux Straits.

The length of the New Zealand group, in all about 1,200 miles, as compared with the average breadth of about 120 miles, is thus accounted for. Also, since the main direction is north-east and south-west between the parallels of 40 and 48 degrees south latitude, the shape and position of the islands is the controlling factor in determining the variations of climate experienced, the types of native and introduced vegetation that flourish, the consequent animal life of the region, and the nature of the communications. It is not too much to say that no better example of the control exercised on man by his homeland is to be found anywhere in the world; and, as we shall see, the features that have just been sketched are everywhere the dominating influence over life in the Dominion.

The second strong influence is the character of the surface throughout the islands. Extending through the whole length of the South Island; but, in general, much closer to the west coast than to the east, runs the great system of parallel folds known as the Southern Alps. On the west side fronting the Southern Ocean as a high rampart dipping steeply to the sea, the system is drawn out on the eastern side into many side spurs and ranges that gradually flatten out towards the extensive plains of Otago and Canterbury. The great glaciers form the chief geographical feature of this true alpine region. Owing to the heavy precipitation and the steep slopes these glaciers assume majestic proportions in the neighbourhood of Mount Cook, the fine peak rising to over 12,000 feet, which was known to the Maoris as Aorangi or Cloud Piercer. The Tasman Glacier is the most notable example, being nearly 20 miles long and about $1\frac{1}{2}$ wide; but others such as the Hooker, Mueller, Fox, and Franz Josef are all over 8 miles in length. Owing to the heavy glaciation in past ages, which

left great moraines piled up across the lower ends of many of the deep valleys, many large and extremely beautiful lakes occur in the southern area. Long, narrow, and enclosed by sheer walls of rock, they lie in the very heart of the alpine ranges. The chief examples of these glacial lakes are Te Anau, Wakatipu, and Manapouri. The Kaikouras in the north-east and the Otago Mountains in the south are detached systems, in general lower than the main range and seldom reaching more than 6,000 feet in elevation. The extreme south of the South Island and Stewart Island are a knotted area whose highest point, Tutoko, rises to 9,000 feet. Of this region Professor Marshall has finely written:

'Sublime in their stark and stalwart forms, sombre in their vesture of forest, the standing rampart of the land to the wet winds of the west, these forbidding ranges are yet untouched save by the foot of the hardiest explorers. The mighty precipices of these mountains, their leaping waterfalls and embosomed lakes, are doubtless due to glacial erosion. . . . Stewart Island is no more than a partly drowned southern extension of this mountain mass.'

There are thus three main types of surface to be met with in the South Island: (i) the true alpine system already described, at the northern and southern ends of which the valleys have been 'drowned' to form the majestic *fiords* to the north of West Cape and the less rugged *sounds* of the coast facing Cook Strait; (ii) the foot-hills or 'Downs' as they are called, a strip of varying width seldom rising more than 2,000 feet and originally covered with dense bush; and (iii) the Plains which are really extensive gravel deposits formed by the action of rivers and glaciers in past ages.

In the North Island the main mountain system lies nearer to the east coast and is more flattened out, as it were, so that the chief summits scarcely reach 6,000 feet. The area, however, has been carved into deep gorges by the Manawatu and other streams, so that it has become a series of rugged blocks, clothed for the greater part with forest. The Tararua,

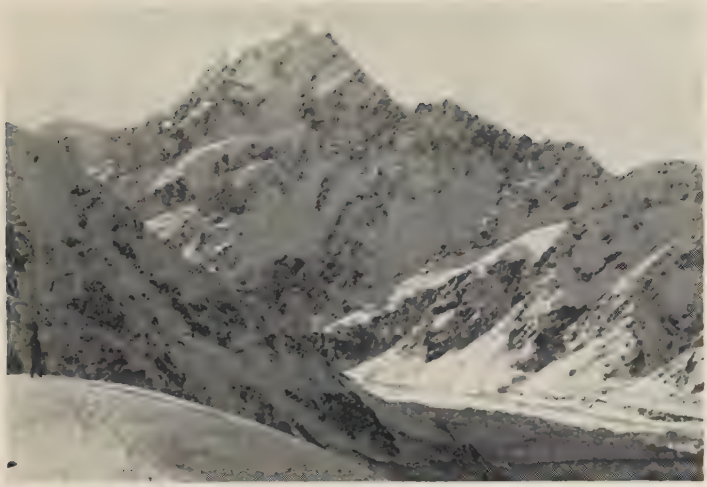

FIG. 67. AORANGI (*CLOUD PIERCER*), OR MOUNT COOK
The highest peak of the Southern Alps, 12,349 feet

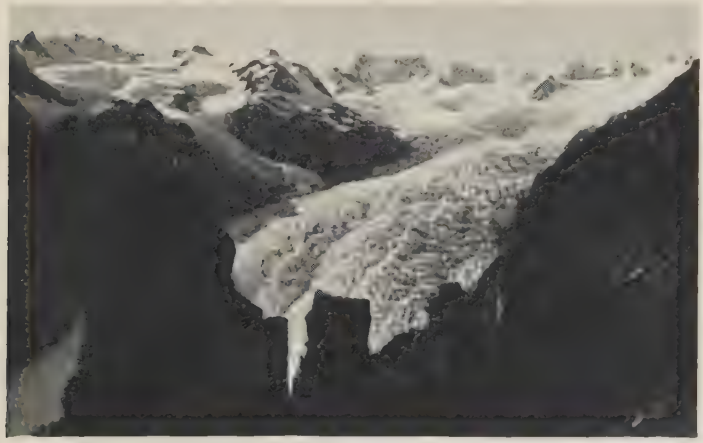

FIG. 68. THE FRANZ JOSEF GLACIER, SOUTHERN ALPS
This region is justly called the 'Switzerland of the South'

Ruahine, Kaimanawa, and Raukumara Ranges preserve, from Wellington to East Cape, the main direction of the southern system. On the west side of the mountain mass there is a stretch of broken country clear across to the west coast, and a narrow belt of foot-hills is found on the eastern side. The plains of the North Island are relatively small in extent, and are confined to the coastal areas on the east and south. There are downs to the west of the volcanic plateau described below.

Lying to the north-west of the mountain region in the North Island is a remarkable volcanic plateau about 50 miles in width, stretching from Lake Taupo to the Bay of Plenty. This is an area where volcanic activity is still prominent, although it is probably in the declining stage; and, as a consequence, the surface is, in the main, a great barren pumice-covered plain. Rising from this plain are isolated volcanic peaks still more or less active. The highest of these, Ruapehu, rises from the centre of the island to 9,000 feet, while Ngauruhoe and Tongariro surpass 6,000 feet. Tarawera, whose destructive outburst of 1886 is still remembered with dread, and the beautiful lonely peak of Egmont are now apparently extinct.

The Thermal Region, as the northern part of the volcanic area is usually called, exhibits the geysers, hot springs, and other activities which are usually associated with the decline of the eruptive stage. The lakes of the volcanic region, too, offer a strong contrast to those of the South Island. For the most part shallow and circular, they occupy basins in the plateau, although a few have been formed by lava dams thrown across the valleys in times of extensive eruption. Taupo, Rotomahana, and Rotorua are the largest and best-known of these lakes. The remainder of the island to the north is much lower, and its chief feature is the wide stretches of sand dunes between the higher portions.

After this general description something more must be said of the downs and plains since these have such an impor-

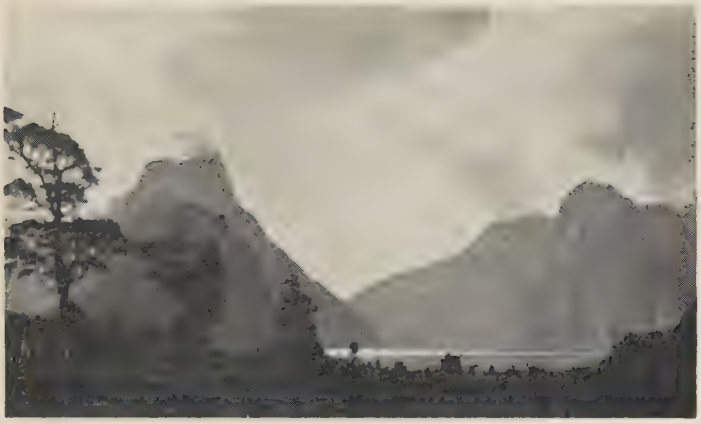

FIG. 69. THE FIORDS OF THE SOUTH-WEST

Milford Sound and Mitre Peak, where the water is as deep below as the mountain is high above

FIG. 70. DAIRYING COUNTRY IN TARANAKI

The chief use to which New Zealand puts its wonderful grasslands. Note Mt. Egmont, an old ash cone, in the distance

tant influence over man's occupations in both islands. The downs of the North Island are really part of an elevated old sea-bed now much eroded and too rugged in general for farming, but forming excellent pastures. The same may be said of the Auckland Peninsula; and the foot-hills of the South Island are pastoral although more amenable to cultivation, but they shade off in the south and west to wild districts still

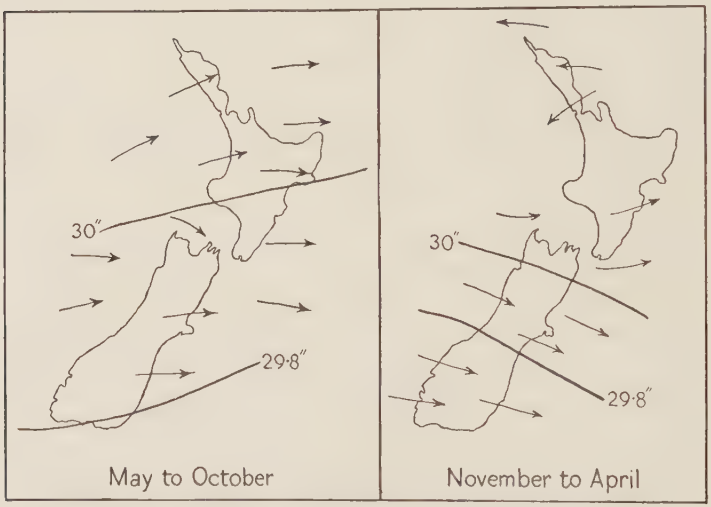

FIG. 71. NEW ZEALAND, PRESSURE AND WINDS

comparatively uninhabited. The plains proper, although a relatively small part of the surface, form the chief farm lands of the Dominion. The most important by far are the fertile Canterbury Plains, an area approximately one hundred miles long by twenty wide, forming the agricultural heart of New Zealand. An area of increasing importance in the North Island is that of the Waikato Valley, still largely undeveloped but rapidly coming under cultivation. Another notable district varying in its character and production from the Canterbury Plains, known as the Southland Plains, extends

behind Invercargill. Smaller, but still important, plain areas occur near Nelson (Waimea and Motueka), Wellington (Wairarapa), Napier (Heretaunga), and the Bay of Plenty.

As would be expected from the 'lie of the land' the rivers on the west of the South Island and the east of the North Island are short rapid mountain streams. Only in the plain country have matured river systems been developed; but few of them are of much use for transport on account of their shallow depth, a bad habit of changing their courses, or because of the sand bars that obstruct their mouths. The rugged gorges through which most of them break at some point on their race to the sea are a striking feature of the landscape in both islands.

A word must be said concerning the coast-line, which, while rich in inlets, is deficient in safe harbours at suitable points for shipping. The west coast is exposed to the buffeting of the prevailing Westerlies and the great rollers of the Southern Ocean, while the east coast is dominated by the south-west current, which piles banks of sand and shingle across most of the entrances. Many fine harbours exist, however, where the coast-line runs across the grain of the country. The harbours of Auckland and Wellington are deservedly noted among the world's best anchorages.

2. *Climate*

Considerable variation in climate will be expected in a country that extends through 8° of latitude; and in which the grain of the country is, in general, opposed to the direction of the prevailing winds. Actually the two main islands are influenced by such different climatic controls that they must be treated separately. Because of its position in relation to the wind systems of the southern hemisphere the North Island has the closest affinity with the Mediterranean type of climate, while the South Island must be placed in the same

Fig. 72. NEW ZEALAND, RAINFALL

climatic group as Tasmania and British Columbia, i.e. the group in about 40° latitude dominated by the prevailing westerly winds. It must be borne in mind, however, that New Zealand, by virtue of its insular position, escapes extremes of temperature; and that its climate is, in general, of the maritime type.

FIG. 73. FOREST AND FERN
Forest country typical of New Zealand

This is borne out by the climatic records which show that the difference between mean summer and mean winter temperature is less than 12° for Auckland while it is only 14° for Dunedin; and that the difference between the highest and lowest recorded temperatures for the whole dominion is less than 50°. Greater differences than these occur, of course, inland; and the frequency of frost increases in proportion to the distance from the coast. Despite this equable climate, the difference between the average summer and winter temperatures is decided enough to give that stimulus of changing seasons which is necessary for the white man. Likewise the advance made by the Maoris beyond other Polynesian races is ascribed to the influence of a climate that called forth their energy and made them plan for a barren winter season.

The chief climatic distinction between the main islands, or more precisely between those parts of the Dominion lying

approximately north and south of a line joining Wanganui and Napier, is due to the different systems which control the atmospheric pressure over these areas. The southern section comes more under the influence of low pressures connected with the westerly wind belt which affect also southern Australia and Tasmania. The northern area is affected by less frequent depressions generated in the equatorial belt and moving from the north-west. These depressions, as they merge into the stronger eastward drift affecting the southern

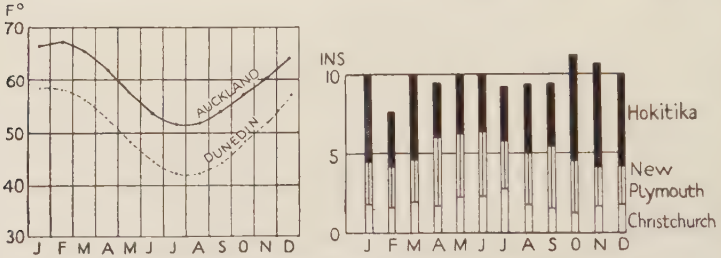

FIG. 74. MONTHLY TEMPERATURES, AUCKLAND AND DUNEDIN
RAINFALL, WEST AND EAST COASTS

area, set up violent storms which result in low temperatures and bring much rain to the eastern side of the North Island.

The 'rain-shadow' effect resulting in a pronounced wet and dry side that has already been noticed in Tasmania is repeated in New Zealand; and the west side of the South Island receives rainfall above 100 inches a year, while the east coast receives on the average only 30 to 40 inches. Part of Otago indeed receives only half of even this relatively low rainfall. Although, on the whole, the rainfall is better distributed in the North Island, there are variations from well above 100 inches on Mount Egmont to an average of about 40 inches in parts to the east. As protracted droughts are comparatively rare, however, this rainfall is everywhere sufficient for agriculture, and in most parts is ample for forests.

Chapter XVII

ECONOMIC SURVEY

1. *Vegetation*

As would be expected, there is a very close relation between rainfall and vegetation which results in a remarkable variety of plant types. From the dense evergreen forests of

Fig. 75. NEW ZEALAND FLAX (*Phormium tenax*)

The leaves are eight to ten feet in length and contain a strong fibre which is much used for binder twine and similar purposes

the wetter valleys and lower mountain slopes to the grass plains of the uplands, and from the sub-tropical forms of the north to the sub-arctic types of the southern highlands, almost every type of plant life is represented. New Zealand is particularly well endowed with hardwoods and softwoods; but the forests are rapidly receding before settlement, and already some of the indigenous trees are becoming exhausted. The most valuable of these is the kauri, a magnificent soft-

wood attaining great dimensions, very slow in growth, and limited to the northern peninsula. The chief timber now obtained from the forests is the rimu, another softwood which is exported largely to Australia. In the south various species of beech are the predominant types. Apart from the timber of the temperate forests the chief plant of economic value is the New Zealand 'flax' (*Phormium tenax*) from the long blade-like leaves of which a strong fibre is obtained.

Probably one-third of the whole surface of the islands is covered with bush of some sort, but the stands of good timber trees do not exceed five million acres. Realizing the very grave dangers of deforestation the Government has now taken control of forest lands; and, in addition, much planting of European pines is being undertaken by private companies on the pumice lands of the North Island. The chief feature of settlement in the Dominion has been the replacement of forest by grasslands. Both soil and climate favour the production of grass, which, in fact, constitutes the chief crop in New Zealand.

The proportions of the Dominion that are devoted at present to forest, pasture, and farm are rather difficult to estimate, but probably 60 per cent. of the whole surface is capable of some use either as grassland or farm. But less than $1\frac{1}{2}$ million acres are cultivated for crops, of which wheat, oats, and turnips are by far the most important. The Canterbury Plains form a great grain factory which produces four-fifths of the wheat crop of the Dominion. The remainder comes mainly from the Southland Plains, where an adjustment, determined mainly by climate and soil, has led the farmers to specialize more in the production of oats, turnips, and potatoes. Oats, however, are also grown on the Canterbury Plains and to some extent in the North Island. In 1926 the average yield per acre for wheat was 30·4 bushels, and of oats 40·2 bushels, both very high yields, compared with 11·2 and 16·6 bushels respectively for Australia. The season 1925–6, how-

ever, was a poor one for Australia but a particularly good one for New Zealand; yet, notwithstanding this, better rainfall and the more fertile soils and more intensive methods of the New Zealand farmer are mainly responsible for the higher yield. The total crop of wheat, averaging nearly 6·2 million bushels

FIG. 76. THE VANISHING NATIVE

A stand of young Kauri pine. Note the smooth solid bole and the manner of branching. These trees take hundreds of years to mature

per annum between 1925 and 1929, about sufficed for the domestic requirements of the Dominion.

One industry which is playing a large part in the export trade is the production of fruit, particularly apples, which are well suited by the climatic conditions around Cook Strait. They find their ideal environment in the valleys of the Nelson Province, where hops also are grown. In 1926 nearly 20,000 acres of orchards were in bearing in both islands.

2. *Animal Life*

New Zealand was originally very poor in native animal life—indeed the only mammals represented were a dog, a rat, and

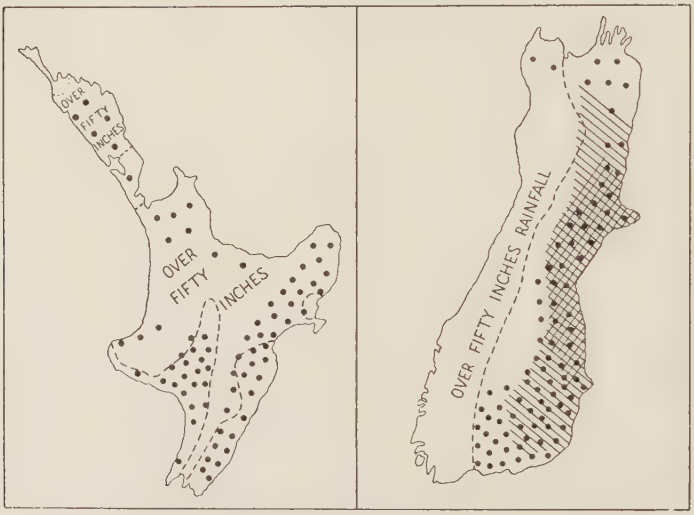

FIG. 77. DISTRIBUTION OF SHEEP AND WHEAT
Each dot represents 200,000 sheep; the wheat areas are shaded

DISTRIBUTION OF SHEEP AND CATTLE

	Sheep.		*Cattle.*	
North Island.	(*Percentage of Total.*)			
N. Auckland	3·3	55·6 per cent.	14·0	81 per cent.
Auckland	4·0		20·0	
Gisborne	12·0		9·0	
Hawke's Bay	12·0		6·0	
Taranaki	3·3		12·0	
Wellington	21·0		20·0	
South Island.				
Nelson	1·5	44·4 per cent.	2·0	19 per cent.
Marlborough	4·5		1·5	
Westland	0·2		1·5	
Canterbury	20·2		6·0	
Otago	12·0		4·0	
Southland	6·0		5·0	

two bats. The dog, or rather his ancestors, probably came with the Maori in the same manner as the dingo is supposed to have reached Australia. A peculiar distinction in the fauna was the number of flightless, or nearly flightless, birds ranging from the great moa, now extinct, to the kiwi, and

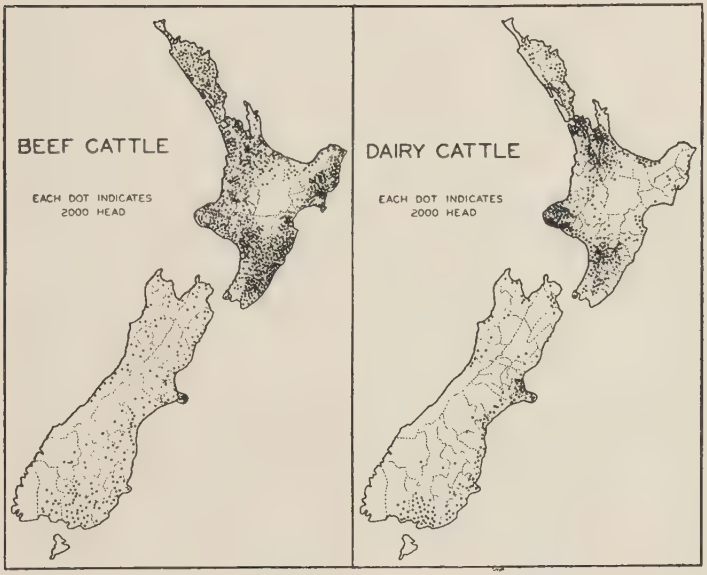

FIG. 78. DISTRIBUTION OF CATTLE

including also forms of the parrot and the duck. These native types are dying out before the advance of the white man and the birds and animals introduced by him. The sparrow, starling, and rabbit, to mention only a few, are examples of introduced types that are proving a serious pest. More useful and attractive immigrants are the deer now numerous throughout the Dominion, and the trout which are now thoroughly acclimatized in all the streams. Anglers find good sport both in these streams and –the more adventurous of them—among the islands off the coasts.

Fish are abundant everywhere; and the introduction of the Alaskan salmon to the glacial streams of the south-west forms a very interesting experiment that bids fair to be successful. Seals abound along parts of the coast, and whales have been the basis of an industry for many years in Antarctic waters.

FIG. 79. WHEAT HARVEST ON CANTERBURY PLAINS

This area is the granary of New Zealand, but it cannot produce sufficient for the needs of the Dominion

The revival which has recently taken place in the industry is due to a change in method whereby a large mother-ship is supplied by many smaller craft. Control is almost entirely in the hands of Scandinavians. Oyster beds, especially round Stewart Island, supply another important item of export.

Since the area under crops in the Dominion is less than $1\frac{1}{2}$ million acres, while the area sown with grass—apart from the rougher uplands that are natural pastures—amounts to about 17,000,000 acres, it is easily realized that the grasslands of

New Zealand form its greatest economic asset. An interesting specialization has taken place in the pastoral industry as a result of which the North Island has developed cattle pastures, more especially for dairying, in addition to sheep raising on the plains. On the other hand, the pastoralists of

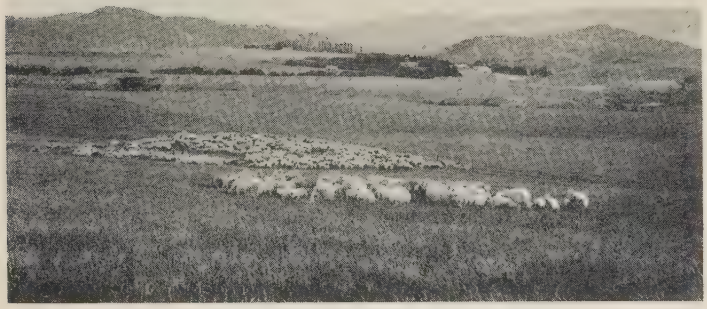

FIG. 80. NEW ZEALAND GRASSLANDS

Typical sheep station near Marlborough

the South Island have given almost all their attention and energy to raising sheep, particularly fat lambs, for export to the United Kingdom. The numbers of sheep and cattle in New Zealand have been steadily increasing with the progress of settlement; but the advance, particularly in cattle numbers, has been very marked in the last decade. In 1930 the Dominion owned about 29 million sheep, $3\frac{1}{2}$ million cattle, and nearly 600,000 pigs, in addition to 300,000 horses. The distribution of sheep and cattle in the different provinces, well shown on the accompanying maps (Figs. 77 and 78), is of considerable interest.

3. *Population*

Few lands are so interesting in the human aspect as New Zealand. The explorers, whalers, and settlers of the early days found here a sturdy and capable race which had already

FIG. 80 A. DISTRIBUTION OF POPULATION

Each dot represents 100 people (outside the cities, the population of which cannot be represented on this scale)

advanced far in the arts and crafts of civilization. The legends of the first tentative explorations leading about A.D. 1300 to the migration of the Great Fleet to Ao-Tea-Roa, or Long White Cloud, as the Maoris called the land, is a record of skill and seamanship unexcelled in the history of any race. But even more remarkable was the adaptation and adjustment by which this Polynesian people, accustomed to the warmer

'Hawaiki' away to the north, developed a system of life that was far in advance of that of any other Polynesian race. Clothing, weapons, dwellings, and agriculture all show the influence of a colder environment in developing energy and stamina.

After the fierce clashes of the first contact between the

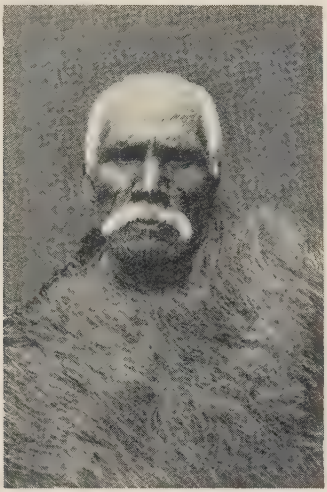

FIG. 81. OLD MAORI CHIEF
Note the regular features and the tattooing

natives and the new-comers had died down, Maori and European both realized that their common destiny needed co-operation rather than destructive competition; and the following years have been a wonderful demonstration of the ability of Polynesian and European to live in peace and mutual helpfulness. The Maoris, numbering about 65,000 (1930), are steadily increasing. The white population, an unusually high sample of European stocks and mainly British, numbered 1,219,000 at the census of 1921, which total had by 1930 increased to about one and a half millions.

4. *Communications*

The railway routes of the Dominion are determined in a more than usual degree by the disposition of the highland masses. Only at one place, i.e. between Christchurch and Greymouth on the west coast, and then by means of a long and expensive tunnel, does a railway break across the barrier of the Southern Alps; while the main trunk line for the South Island runs clear through the plains of Canterbury and Otago with many spur lines running back into the valleys cut by the streams. In the North Island the transport problem on land is somewhat easier, although very difficult grades occur on the main line from Wellington to Auckland which runs along the west side of the highlands. A second line from New Plymouth in the extreme west to Napier on the east cuts across the main trunk. Napier is also connected via Wairarapa Valley to Wellington. Branch lines to North Auckland and to the Thermal District complete the system at present, and a short detached line runs back inland from Gisborne. The sea routes, as for all islands, are more important than the land routes in respect to freight carried; and the chief lines of communication are the two trans-Pacific routes via Auckland and Wellington; the routes from Auckland, Wellington, and the Bluff to Australian ports; the ferry services between Wellington and South Island ports, especially Lyttelton; and the routes connecting the outlying ports.

5. *Industry and Trade*

The principal manufactures of the Dominion are connected with the processing of food and raw materials, e.g. flour-milling, tanning, and soap-making, or with the preparation of wearing apparel or the assembling of machinery, although some textile and hardware factories of a more ambitious type exist. These manufactures and others of a 'local' type are centred in the four main cities.

Auckland (209,000) is the largest city, situated on the very beautiful Waitemata Harbour. Its position in relation to the trans-Pacific routes and its railway connexion with Wellington, the political capital, give Auckland a 'cross-roads' position that has been responsible for its commercial status. As the centre of a dairying, fruit, and timber-producing district Auckland has a steady flow of trade. It is also the collecting centre for the curious 'gum-digging' industry of

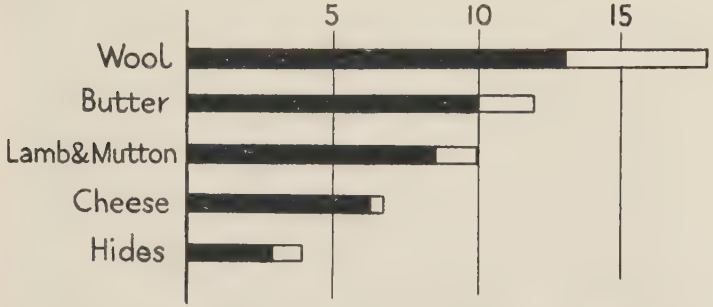

FIG. 82. VALUE OF PRODUCTION IN MILLIONS STERLING
Highest yield for 1 year, and 5-year average (black)

North Auckland, based on fossil gum from ancient kauri forests, which is much valued for varnishes. Gold production is still important but declining.

Wellington (133,000), the second manufacturing city and the seat of the Government, is situated at the extreme south of the North Island on the magnificent land-locked harbour of Port Nicholson. A great deal of the importance of the city is due to its central position and to its command of routes in all directions by both land and sea, including the sea-route to Christchurch, which forms the chief connecting link between the two main islands.

Christchurch (about 125,000), in an extremely beautiful situation on the River Avon, is the natural capital of the rich Canterbury district. It exports through Port Lyttelton the

meat, wool, wheat, and other products of the region. Its connexion by coastal rail with the towns of *Oamaru*, *Timaru*, and *Ashburton*, and with the two big centres in the southern provinces, is a factor in its importance.

Dunedin (about 85,000) is the commercial and educational centre for the southern end of the South Island, and the

FIG. 83. WHALING IN THE SOUTH PACIFIC

This industry is again becoming important. Note the powerful little vessel from which the harpoon is shot, and the icebergs typical of these latitudes. The catch is towed back to a 'mother-ship' of 10,000 tons or more where 'rendering down' takes place

central point of a prosperous agricultural and pastoral district. It is connected by rail with Bluff, the port of *Invercargill* (23,000), the most southerly town, the first point of call for steamers from the west using the southern route.

Other important centres in the Dominion are: *Napier* (19,000), the main port for the sheep-farming district lying around Hawke's Bay. *Hastings*, about 20 miles farther south, is an inland pastoral centre. *New Plymouth* (17,000) is the chief port of the rich agricultural and dairying district of

Taranaki and an important rail-head. *Palmerston North* (21,000), *Feilding*, and *Wanganui* (28,000) are other collecting points for a great pastoral region which is also noted for the production of flax. *Hamilton* (17,000) is destined to become an important farming centre. *Rotorua* is the chief town of the Thermal Region, dependent largely on its attractions

FIG. 84. POWER SCHEME

At Mangahao, Wellington Province. Note the rugged nature of the country

as a tourist resort and spa. *Nelson* (12,000) is the natural head of the chief fruit-growing district of the Dominion at the north of the South Island, while *Blenheim* is the port for the Marlborough pastoral district.

On the west coast of the South Island the small towns of *Westport* and *Greymouth* owe their importance to the 2,000,000 tons of excellent coal raised annually in the fields of the district. Deficiency in coal throughout the Dominion is compensated for by the ample water-power available for genera-

tion of hydro-electricity. The largest generating stations are at Lake Coleridge near Christchurch; at Arapuni Rapids, on the Waikato River, which is one of a linked series of stations which will supply power to the whole of the North Island; at Lake Waikaremoana; and at Mangahao, the chief source of power for Wellington and district.

The industries that bulk largest in the figures for the over-sea trade of the Dominion are, of course, those that are dependent upon the pastures, viz. dairying and sheep-raising. More than 90 per cent. of the total exports is made up of the products of the grasslands. On the average value of exports for the last five years the percentages for the chief export items were: wool, 30; butter, 22; meat, 20; cheese, 14. The values of the chief items for the year of greatest production in last 5-year period, and the 5-year average, are shown in Fig. 82. The direction of exports and the sources of the bulk of imports are shown in the following table:

NEW ZEALAND EXPORTS AND IMPORTS BY COUNTRIES

	Exports.	*Imports.*
Great Britain	80 per cent.	50 per cent.
United States	6 ,, ,,	15 ,, ,,
Australia	5 ,, ,,	12 ,, ,,

BIBLIOGRAPHY TO PART IV

Year Book of New Zealand. Government Printer, Wellington.

Reeves, W. Pember. *The Long White Cloud.* 1924. (Allen & Unwin.)

Laing, R. M., and Blackwell, E. W. *Plants of New Zealand*, 1927. (Whitcombe & Tombs.)

Hutton, F. W., and Drummond, J. *The Animals of New Zealand*, 1923. (Whitcombe & Tombs.)

Marshall, P. *New Zealand*, pp. 375–461 in vol. v of the Oxford Survey of the British Empire. (Clarendon Press.)

F. von Hochstetter. *Geology of New Zealand.*

PART V

THE PACIFIC ISLANDS

Chapter XVIII

THE CONTINENTAL ISLANDS: MELANESIA

It is almost an impossibility in such a short account to give an adequate treatment of the great number and variety of islands scattered over the face of the Pacific. In the early chapters of this book there is much of a general nature that need be repeated; but even so the task of including some description of the more important groups and of islands that range from great areas like New Caledonia to tiny atolls is quite formidable. All that can be done, therefore, is to select areas that are, as far as possible, typical. It may be said that the islands to be found in the Pacific fall into three main classes, viz. (i) the large continental islands or groups such as New Caledonia and the New Hebrides. In this class only those islands that are not more easily treated with continental regions will be chosen; (ii) the volcanic groups, such as Fiji and Hawaii; and (iii) the innumerable atolls and atoll groups of Polynesia and Micronesia.

Even with such a variety of soil and structure as is found in the islands of the Pacific, it will be seen that there are close resemblances in modes of life, occupations, cultivation, and even physical characteristics, which spring very largely from similarity of climate over this wide area. The economic plants, coco-nut, banana, taro, sugar-cane, pine-apple, to name only a few that find in these islands the most suitable conditions for their growth, have such an immense effect upon life and thought and even scenery in the South Seas that a very great similarity is inevitable.

On all the islands where volcanic action has been prominent a sequence of surface may be regularly observed, and this, of course, does not refer solely to the mid-Pacific groups, but applies with equal truth to continental islands like Java and New Caledonia. The sequence runs somewhat in this way. At the sea-level are seen the beaches and sand-dunes

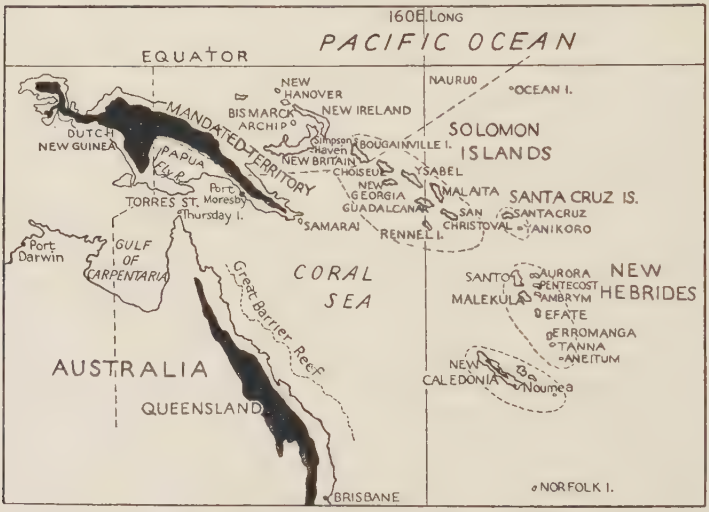

FIG. 85. NEW GUINEA AND CONTINENTAL ISLANDS
Highlands shown black

or the coral-flats that are the result of the raising of a reef. These raised reefs gradually acquire a coating of soil and in time some vegetation, notably coco-nut palms. Behind the beach line are the coastal plains and alluvial areas built up by the streams descending from the interior slopes. Abutting on these lowland areas may be the steep ends of the lava flows now presenting a sheer wall of cliff, or more sloping flow surfaces where the lava has flattened out on its way to the sea. Behind these again may be a high treeless lava-plain that represents a recent flow level, or a swampy plateau if the

mountain is older and lower. Or the summits may have been carved away into the narrow, ridgy divides that make such irregular skylines.

Something can be said also in general terms of the uses which man finds for these different areas. The beach zone is of little use except for coco-nuts, but the alluvial plains lying at the back are often the most fertile belts in the island. Here rice, taro, sugar-cane, and bananas are found almost invariably. Above these the pine-apple finds a situation that suits it, but the steepest slopes are uncultivated. In these two belts a great variety of other fruits may be found, from the paw-paw on the flats to the guava and coffee of the higher levels. The uplands may be used for pasture, but the main life will be found between sea-level and 2,000 feet above it.

1. *New Caledonia*

One of the parallel submarine ridges which extend between New Guinea and the Auckland Peninsula emerges at about 20° south latitude to form the long island known as New Caledonia. This great section, 250 miles in length and 30 40 miles in breadth, is, after New Zealand, the largest of the truly Pacific islands. In structure, character of the plants and animals, and native inhabitants it is very closely connected with New Guinea. As the ridge sank beneath the ocean coral reefs were built up, so that now both the eastern and western shores are fronted by continuous reefs; that on the western side is one long stretch for 400 miles, and is only second to the Great Barrier Reef. Parallel ranges rising to nearly 6,000 feet run the length of the island, and the numerous short rivers have gouged channels that make the island very rugged.

New Caledonia offers a remarkable contrast to some of the other islands that have been studied, particularly the South Island of New Zealand and Tasmania. It will be noticed that the main direction of the mountain ranges in New Caledonia —the grain of the country, so to speak—is the same as that

of the prevailing winds, i.e. the south-east Trades. As a consequence only the northern and southern ends of the island are well watered, and many parts of the interior are almost desert-like in their aridity. A feature of the landscape is the very serrated appearance of the mountain ranges, which, because of the erosion effected by the streams everywhere,

FIG. 86. COCO-NUT PLANTATION, SOLOMON ISLANDS

The trees commence to bear fruit when six years old, and mature trees yield about 60 nuts a year

appear to adhere to no particular system. In contrast to most of the islands in the sub-tropical areas New Caledonia is not, generally speaking, heavily forested. Although great kauri forests do occur, much of the surface is grassland or covered with a light scrubby growth.

The average temperature is about 72° for the hot season (December–March) and 65° for the cool months (June–October). The extreme range is from 98° to 50°, and frosts are unknown there. The climate is far less humid than that of most islands similarly situated, an effect of the arrange-

ment of the mountains that has just been mentioned. Rainfall varies greatly as between localities. Nouméa, on the west side of the island, has a fall of about 40 inches a year; but 70 per cent. of this is concentrated in the hot months. In this season, too, storms of a cyclonic character—the dreaded hurricanes of the planters—frequently develop, and occasionally they move right across to the interior of Queensland.

FIG. 87. THE COPRA INDUSTRY

Native labourers gathering coco-nuts. Typical of any plantation area in Melanesia

The dark skins, frizzy hair, and decided features of the natives of New Caledonia indicate a very close connexion, racially, with the natives of New Guinea, and a clear distinction from the inhabitants of the islands of Polynesia and New Zealand. The decline in their numbers after the contact with the white races is most tragically marked. The French found a population estimated at 70,000 when they took over the territory in 1853; but the onset of European diseases, and changed ways of life, have diminished the numbers to about 25,000. Few of the natives of Pacific islands take kindly to the

rigid hours of work during the day favoured by the white man. The native's own way of working in the cool of the morning and evening or, more often, when he feels inclined, and his preference for leisured ease during the heat are, of course, of no use where the steady work of a plantation is called for. The lack of inclination for such work on the part of the native has led, in New Caledonia as elsewhere, to the introduction of Asiatic labour. The French have imported numbers of Japanese, Javanese, and Tonkinese into New Caledonia mainly for work in the plantations and mines. This mixture of peoples brings with it many troubles in administration, and introduces also social problems of a very difficult nature. The island was originally a French penal settlement, and although transportation ceased about 1900, many of the present white population came as exiles. The white population numbers about 19,000.

New Caledonia is notable for the extent of its mineral wealth. This mountainous territory has proved deposits of chrome, cobalt, antimony, mercury, silver, lead, copper, and many other minerals. Nickel, however, is the chief item in the catalogue. More than half the surface is too rugged for cultivation, but it is in these areas that the known and possible mineral resources exist. The valleys are very fertile but, owing to the lack of suitable labour, undeveloped for the greater part. The land of the island is divided into three 'domains', state lands, the penal settlements, and the native reserves, but very little of the native portion is reasonably productive. The chief products for export are copra, coffee, cotton, minerals, and maize. Others are hides, trochus shell, bêche-de-mer, sandalwood, and tropical fruit such as bananas. The bêche-de-mer or trepang is a 'sea-slug' about 10 inches long, which is dried and exported to China. Sandalwood is esteemed because of its peculiar aroma, and finds a market also in China.

Nouméa is the chief port and seat of government, with a

population of about 9,000 people. It is placed on an excellent harbour, well protected from storms. Trade is mostly with Australia, in fact 60 per cent. is between Nouméa and the east-coast ports of Brisbane and Sydney. A wireless station has been erected at Nouméa, and a cable connects *Téoudie* with Bundaberg in Queensland.

2. *New Hebrides*

Lying to the north of New Caledonia is the group known as the New Hebrides. These islands are of interest from many points of view. The origin and customs of the natives and their relation to the other peoples of the Pacific, the peculiar nature of the government of the group, and the geological history are all unusual in some respects. Another matter of interest is their connexion with Australian history. De Quiros in 1606 discovered the most northerly island of the group, and the word Australia was used for the first time in the name that he gave to the land that he mistakenly thought was the great southern continent.[1] Captain Cook on his first long voyage of discovery in the Pacific was the next visitor. He explored the group and gave it its present name. The most important islands are Santo, Malekula, Aurora, Pentecost, and Efate, tapering from blocks of considerable size such as *Santo*, in the north, 75 miles by about 40 wide, to small but very productive islands like *Aneityum*, in the south, with a circumference of less than 40 miles. The whole group is very mountainous; but the elevations of nearly 6,000 feet in the north fall away to peaks of less than 3,000 in the south. Apparently largely volcanic in formation, the islands carry soils of great fertility, and most of them sustain heavy forests. The wide valleys carved by the numerous streams are the chief centres of population, but many of them, formerly the seats of a busy native life, are now deserted. Being in the zone where coral building activity is at its

[1] *Terra Australia del Espiritu Santo*, Southern Land of the Holy Spirit.

greatest, and also being subject to marked volcanic upheavals, the coasts of this group display a more definite coral structure than any of the other large islands.

The climate is more nearly typical of the region than that of New Caledonia both for temperature and rainfall. Great variations in rainfall occur, but in the New Hebrides nothing like the aridity of parts of New Caledonia is found. The prevailing wind-direction, however, results in a pronounced difference between the vegetation of the east and south, where the Trades have their maximum rain-bearing effect and result in luxuriant vegetation, and that of the west and north where heavy growth is notably absent.

Just as the New Hebrides form a group in which the geological characters of the continental islands merge into those of Polynesia, so it forms a transitional area in the matter of population. There is a very interesting mixture of peoples and languages here which combines the characteristics of both the Melanesian and Polynesian peoples. In colour there is every variation from the sooty black, woolly-haired negrito type leaning towards the Papuan, to the taller lighter-coloured Polynesian. It is claimed that at least twenty different languages are spoken by the 50,000 natives scattered through these islands.

The saddest page in the history of the Pacific turns on the visits of traders and whalers after 1800; and to their outrageous treatment of the natives was added the horror of a slave trade known as 'blackbirding'. The natives, called generally 'kanakas', were recruited by shameful and forcible methods for work on plantations, particularly on the sugar-plantations of Queensland. Added to this injury were the diseases introduced by the whites. It is not to be wondered at that a great decline took place in the numbers of the natives, and that suspicion and distrust of the white man and his works became deeply rooted in the minds of the people of the New Hebrides.

The government of the group presents an unusual and not particularly happy experiment. By means of an agreement known as the Condominium Pact the British Government, whose nationals first occupied the land, and the French Government who claimed the island as a result of the proclamation of 1871 but had few settlers there, it was arranged

FIG. 88. EXTRACTING THE COPRA FROM COCO-NUTS

The nuts are 'husked', i.e. cleaned of the fibrous cover, and split, either on a sharp stake, or by means of an axe. The white kernel is then 'shelled out' to dry in the sun or in a kiln

to govern the islands jointly. The Pact reads, 'The group of the New Hebrides shall form a region of joint influence in which the subjects and citizens of the two Signatory Powers shall enjoy equal rights of residence, personal protection, and trade, each of the two Powers retaining jurisdiction over its subjects or citizens, and neither exercising a separate control over the group.' The Joint Court, which is the chief instrument of the Condominium, is the place for the arbitration of the claims between French and British; but the interests of

the natives tend to be lost sight of in the process of settling disputes between the whites. And there is no area which calls for single-minded administration in the interests of the native more than does that which is under the control of the Condominium.

Efate, one of the smaller southern islands, has two excellent harbours in *Vila* and *Havannah*, and, largely because of this, the seat of the dual Government is situated at Vila. As the head-quarters of both the British and French officials, and the commercial centre for the southern part of the group, it has become the most important settlement. The corresponding hub for the northern section is at *Segond Channel* on Santo. *Malekula* is the second largest island with a large number of important plantations and some good harbours, the lack of which definitely hinders the development of some of its neighbours such as *Aurora*. The interior of both the large islands is largely unknown territory inhabited by wild tribes. *Malo* and *Aoba* are both very productive smaller islands, while *Tanna* and *Ambrym* are noted for possessing very active volcanoes. Parts of this coast have risen 60 feet since the visit of Captain Cook. *Aneityum*, an exceedingly productive spot, now has a population of a few hundreds in place of the 12,000 of fifty years ago.

3. *The Solomon Islands*

Structurally connected with the New Guinea mountain system, and generally volcanic in formation, the Solomon Group lies 10° nearer the equator than the New Hebrides. The group comprises very many islands of varying size but with an average area much larger than those of the New Hebrides. The two groups are alike in being arranged in double rows, the summits of partly-submerged ranges. The chief members of the group are *Bougainville*—the largest, about 140 miles long by 35 wide—*Choiseul*, *Ysabel*, *Malaita*, *Guadalcanar*, *New Georgia*, and *San Cristoval*. No

other group has been so intimately connected with the exploration of the Pacific as the Solomons. The Spanish navigators Mendana, De Quiros, and Torres, the French explorers Carteret, Bougainville, La Pérouse, d'Urville, and D'Entrecasteaux, and many English sailors from Shortland to Hunter have had a share in the discoveries of these islands. The British Government declared a protectorate over the southern part of the group in 1893; and, with the exception of Bougainville and Buka, the group became entirely British when Germany handed them over by treaty in 1900. The total area of the group is calculated to be 15,000 square miles spread over about 50,000 square miles of ocean. Elevations are intermediate between those of New Guinea and the lower heights of the New Hebrides; and peaks of 7,000–8,000 feet are known.

Its situation within 10° of the equator brings the group into the belt of equatorial calms in the hot season (November to March), and the climate in general is nearer the equatorial than the mid-Pacific type. The change of season occurs from April, when the south-east Trades move northward with the sun. Temperatures of 92° maximum, and 72° minimum, with high humidity especially in the hot season, emphasize the equatorial character; and the region is not nearly so favourable to white settlement as the more southerly islands. Malaria and dysentery, to name only the major troubles, are very prevalent and the natives seem particularly susceptible to their ravages. The rainfall varies very greatly both in time and in amount, but the more settled parts are known to receive between 80 and 100 inches in the year.

Planting on a large scale has been a feature of the development here since large soap-manufacturing firms decided on the suitability of the Solomons for the purpose of copra production under the plantation system; and, since 1905, very large areas have been developed. The main difficulty, here as elsewhere, has been the provision of suitable labour; but in

the decade 1920-29 nearly 100,000 tons of copra were exported.

Like the people of the New Hebrides the Solomon Islanders show signs of considerable racial mixture, although the Polynesian traits are only pronounced in the coastal districts. By nature fierce and suspicious, the native temper has not been improved by experience of western methods of approach; and the group presents one of the most difficult problems of administration in the Pacific. The difficulty is intensified by the bewildering jumble of language and dialect. No less than forty different modes of speech have been traced in the group. The numbers of the native population are not known with any exactness, and the figures quoted from time to time are nothing more than skilful guesswork. Some islands are densely populated; *Malaita*, for instance, has at least 50,000 inhabitants and may well have twice that number, while some of the other islands are equally populous. Only about 5,000 natives are working on the plantations. Depopulation is just as great a tragedy as in some of the other groups. Settlements that fifty years ago could number 5,000 inhabitants could not total so many hundreds now. *Vanikoro*, in the Santa Cruz group, has less than 100 people in place of its former population of 3,000.

Tulagi, in a central position on a small island midway between Malaita and Guadalcanar, is the chief port and centre of government for the Solomons. Other ports, mainly for the collection of copra, are *Gizo*, *Faisi*, *Aola*, *Makira*, and *Malaita*. Almost the whole of the copra production is exported to Sydney, although there is a growing trade connexion with the United States.

Note.—The coco-nut palm comes into bearing six or seven years after planting. The nut is split and the white kernel when dried becomes the highly odorous copra of commerce. A native labourer will collect and split 300–400 pounds of 'green' copra in a day. This is then dried in kilns and the weight is reduced by about half.

Chapter XIX

THE VOLCANIC GROUPS OF THE MID-PACIFIC: POLYNESIA

As the economic geography of these islands depends so directly upon their structure a brief description of their formation will be in order. Typically these islands have been

'built up by flow after flow of basaltic lava. These flows thin out as they leave the centre of eruption until a gigantic dome is built

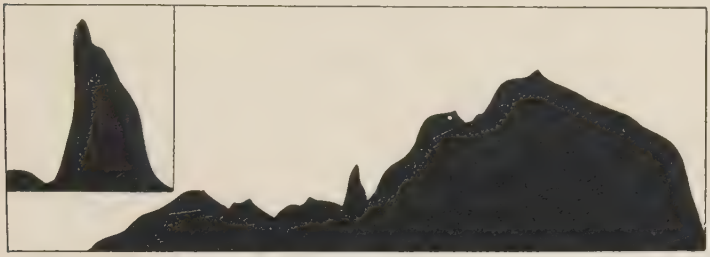

Fig. 89. PROFILE OF MOOREA, SOCIETY ISLANDS

up above the sea. The diameter of such a dome may be ten to thirty miles at sea-level, and its height from a few thousand to over 13,000 feet. As a final stage of vulcanism several subsidiary volcanoes may break out on the slopes of the great dome and cinder cones be left as a result. Consequent streams radiating out in all directions from the dome would begin to dissect it as soon as it arose above the sea. . . . Corals may add their mite to the extension of the island and the reefs may be elevated to form land.' (Otis Freeman.)

This description of Hawaii holds good for most of these volcanic groups, although they vary very much in age, and consequently in the degree to which the weather has affected them. The basalt weathers very easily, but where the flows are of recent origin, as in the case of Haleakala and Mauna Loa, the original dome-like profile is still preserved. Where

erosion has gone further, and particularly in the case of ash cones, the old crater walls are broken down and serrated into most unusual shapes and outlines. The upstanding peaks and knife-like ridges of these regions form one of the wonders of the Pacific from Hawaii to Tahiti. Where the elevation has reached 3,000–5,000 feet in the trade-wind belt the mountains enter the zone of maximum rainfall and very heavy annual falls are usual. Some importance attaches to this in consequence of the effects upon distribution of rainfall and upon stream flow in the islands.

1. *The Fiji Islands*

The Fiji Group, as we have already seen from the study of New Zealand, represents an unsubmerged portion of a mountain fold stretching under the sea for thousands of miles in a north–south direction. The structure of the islands is highly volcanic, although no activity is apparent in the group at the present time. There are more than 200 islands in the group, all very mountainous, all ringed with reefs, and for the most part fertile and inhabited. The two main islands *Viti Levu* (Great Fiji) and *Vanua Levu* (Great Land) make up three-fourths of the surface area.

In nearly the same latitude as Fiji lie four other groups of very similar formation and production. These are Tonga (or Friendly Is.) and Samoa (or Navigator's Is.), about 400 miles to the south-east and north-west of Fiji respectively. Another 800 miles to the eastward are the relatively less important groups, with smaller islands more scattered, known as the Cook Is. and Society Is. All consisting of volcanic cones more or less broken down by weathering and ringed by coral reefs, situated in the same climatic region, and peopled by similar stocks, these groups form a very similar environment; and so we shall find occupations and productions of a very similar nature everywhere. Historically they are of great interest since many of the events affecting Australia have also

had some connexion here. The great Pacific explorers De Quiros, Tasman, and Cook made many contacts, and Cook in particular has a very intimate connexion with most of them, as he has with Hawaii far to the north.

The chief features of the islands are the sharp and jagged outlines of the ancient crater walls and volcanic ridges, the

FIG. 90. THE SUGAR INDUSTRY IN FIJI
Cane-fields, refinery, and jetty typical of the industry

dense vivid green vegetation stretching right from the water-line to the highest summits, and the abundance of well-fed streams. The seaward current of fresh water maintained by these rivers prevents the growth of reefs opposite their mouths and consequently these breaks form the chief entrances for shipping, while the reefs provide a natural breakwater.

The Fiji Islands are in the trade-wind belt of the south Pacific; and, as usual in such situations, they have a pronounced wet side. The climate is strictly of the mid-Pacific type, with maximum temperature of 90° and a minimum of

63°, giving a daily mean of about 79° for the year. January and February, the two hottest months, are also the rainiest; though there is very little noticeable variation in temperature between the seasons. Another feature common to the mid-Pacific type of climate is the uncertainty and variation in the amount and the time of the rainfall. At Suva the annual fall

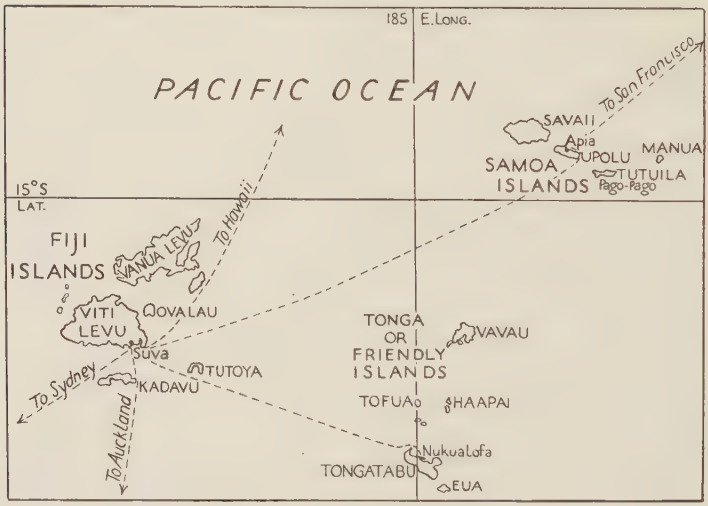

Fig. 91. FIJI, TONGA, AND SAMOA

is between 90 and 100 inches, but some parts of the group receive much more and some much less. Another characteristic of the area is the occurrence of violent local storms of the hurricane type which, while not frequent, are exceedingly destructive.

The population of the group at a recent census showed that there were nearly 160,000 people in the group, composed principally of Fijians (84,000), Indians (60,000), Europeans (4,000), and Chinese (900). Although not a true Polynesian, in fact he is very different in many characteristics, the native Fijian is distinguished by splendid physique, great intelli-

gence, and marked independence, and is intent on preserving the ancient customs and privileges of his race. The British Government of the islands allows the control of native affairs to be vested in the Fijians themselves as far as possible, and the people are exceedingly jealous of the British connexion. Many of the Pacific groups have difficult problems because of the mixture of racial stocks that is taking place, in some cases with great rapidity. Fiji is one of such groups. The presence of the large Indian colony which will doubtless soon outnumber the Fijians is due to the need for labour upon the plantations and in the mills of the island, a form of work for which the native displayed no liking. The Chinese group is formed of traders and merchants mainly interested in copra production.

The chief industry is, of course, agriculture of various kinds. Fiji has for many years been noted for the quality and size of its fruit, particularly bananas. Indeed, banana cultivation right through the mid-Pacific must be noted. Its value as a food plant is enormous and one acre is calculated to produce over 30,000 pounds of fruit under favourable conditions, a far greater yield than is possible from any other crop. The growing of sugar-cane on a large scale, and of pine-apples, coco-nut, rubber, kapok, rice, and even tea and cocoa will afford some idea of the great variety of production, and the list is by no means complete. The refining of sugar close to the great plantations is the chief manufacture carried on in a large way. *Suva*, on a beautiful harbour, is the capital and chief commercial centre, forming a port of call on one of the main trans-Pacific routes, with sugar, bananas, and copra as the chief trade items. On the Rewa River, 12 miles away, a large sugar-mill is established. *Levuka* on the island of *Ovalau* is the chief collecting and export centre for the copra, while at *Lautoka*, situated in the chief sugar district of the group on *Viti Levu*, is another large sugar refinery.

2. *Samoa or Navigator Islands*

This group is politically divided. Western Samoa, consisting of *Savaii* and *Upolu* with other islands, is administered by New Zealand under mandate from the League of Nations; while other islands to the east, of which *Tutuila* and *Manua* are the chief, belong to the United States. The climate of this group is more decidedly seasonal, owing to its situation nearer the equator. January, February, and March are usually the hot season, quite distinct from the later and cooler months.

Cultivation is carried on both under the plantation system and by the natives on their smaller holdings. Coco-nut for copra is the staple of the group; but most of the tropical fruits are grown. The native agriculture is particularly connected with the growing of yams and taro; and bread-fruit, as in most of the other islands, is prominent. The taro furnishes the chief food, and merits some further notice on account of its importance in native diet. The plant, with large leaves like those of a lily, grows mainly in rich mud, and develops a large tuberous root. In these islands it is pulled, the top cut and replanted, and the root cooked and used like a vegetable. In Hawaii and Fiji it becomes the basis of a starchy food called *poi*.

The population of Western Samoa numbers 40,000, of whom 39,000 are native Samoans, and a thousand are whites engaged in planting, administration, or trade. The Samoans ever since the early visits of Captain Cook and others have been noticed for their good looks, splendid physical development, and pleasant manners. They are true Polynesians, very closely allied to the Hawaiians in the north and the Maoris in the south, and many writers regard Samoa as the half-way house of the great migration from Hawaii to New Zealand. By others it is regarded as the original home of the race and 'Savaii disputes with Hawaii the honour of being . . . the traditional Hawaiki whence the ancestors of the Maoris of

FIG. 92. SUGAR-CANE ON TRUCKS

In the mill-yard, Lautoka, Fiji

FIG. 93. NATIVE VILLAGE, SAMOA

Grass huts and coco-nut palms typical of all mid-Pacific islands

New Zealand migrated to the great southern islands. Both names—Savaii and Hawaii—would be pronounced Hawaiki by a Maori, but the word may have only a general meaning, like the word "home" in English.' The native pronunciation of Hawaii, it is worth noticing, is as near to Hawaiki as the English can render it, the *k* becoming a peculiar guttural click for which we have no symbol.

Upolu, the chief island, is so very beautiful in its alternation of mountain and smiling valley, forest and plain, that it is deservedly called the 'Paradise of the Pacific', and Robert Louis Stevenson, the Tusitala or Teller of Tales to the Samoans, is immortally associated with the island. *Apia*, the capital of western Samoa, is the chief settlement on the island and is beautifully situated on a reef-protected bay. The whole island is about 500 square miles in extent, and Apia is the port for the copra which is the chief source of wealth. *Savaii*, the largest island, rising to summits of 4,000 feet, has an area of about 750 square miles. Its volcanic structure is of such recent origin, however, that it is far less fertile than its smaller neighbour.

Eastern or American Samoa has a total population of about 9,000. The island of *Tutuila*, about 24 miles long and 6 miles at its widest, is the most important of the group. It is a rugged mountain ridge with little level land, and that around the coast only. The Government is situated at *Pago-Pago* (usually pronounced Pango-Pango), remarkable as the interior of a submerged crater breached on the seaward side. 'About a mile from the harbour mouth it turns sharply to the westward, giving the harbour the appearance of the foot of a stocking with the United States naval station situated in the instep, facing north and entirely sheltered from the seaward. The sea cannot be seen from ships at anchor inside the harbour, and ships lie quietly in smooth water during the heaviest gales.'

As in western Samoa, December to March are the hottest

and rainiest months, and the annual rainfall at Pago-Pago is nearly 200 inches, but there is a wide yearly variation between 130 inches (1905) and 300 inches (1908). Average monthly temperature ranges from 79° to 82°. Production is along the usual lines, and almost the only item of export is copra.

3. *Tonga or Friendly Islands*

This is a group of about a hundred islands, varying greatly in size and structure and scattered over a wide expanse. The 'high' islands to the south are the remains of old volcanic peaks, and as the ridge runs northward the peaks are more and more submerged until they become low coral platforms almost at sea-level, the 'low' islands. The three main sub-groups are known as *Tongatabu*, *Haapai*, and *Vavau* from the largest islands. Politically the group is very interesting as it is an independent monarchy under the protection of Great Britain. The population is about 27,000, of whom 600 are whites mainly engaged in copra planting or trading. Copra to the value of nearly £300,000 is exported each year.

The capital, *Nukualofa*, is situated on the low-lying island of Tongatabu. The entrance is marked by the intricate windings of the coral-reef, by the foam of the surf, and 'by the brilliant variegation of colour in the shoal water, the unusual contour of the low-lying coral islands with their beaches of yellow sand or fringe of dashing breakers, and by the novel character of the vegetation, indicated in the distance by the feathery heads of the coco-nut palms silhouetted against the sky';[1] all very characteristic of the larger Pacific islands.

Among its comparatively few plants is one of extraordinary interest, the sensitive mimosa. It is a pest in its extent but has delicate foliage and fluffy pink flowers. 'Brush its leaves ever so lightly and they shrivel up as with a blight, and if you walk where it forms a turf, your footsteps are marked by the shrinkage of its foliage. Its apparent blight, however, lasts

[1] P. S. Allen, *Handbook of the Pacific Islands*.

only for a few minutes, and then it slowly expands and rises again.'

Eua, to the south, is a volcanic peak 1,000 feet high, while *Haapai* is the port of Nomuka, which gains some interest from its connexion with the mutiny of the *Bounty* in 1798. After leaving this port the crew set their commander Bligh adrift, and he made a marvellous passage in an open boat to Batavia. *Vavau* is one of the most northerly 'low' islands, and is of interest from the way in which a great coral bed has been raised from the ocean to form the main island.

4. *The Cook Islands*

These form a widely scattered group of small islands, mostly volcanic in formation, of which the largest is *Rarotonga*. They are, politically, a dependency of New Zealand. Rarotonga is a much broken-down volcanic peak, rising very abruptly to 3,000 feet, and ringed by a coastal plain extending back into the interior in beautiful and fertile valleys. The circumference of the island is only about 30 miles, and the settled part of the island is a mere ring of cultivation round the coast. The island has assumed some importance as a port of call for mail steamers on the Auckland–San Francisco route; but there is no real harbour, and with the exception of small trading vessels which are able to pass the reef the ships lie out in the offing. About 8,000 people are mostly engaged in growing bananas, coco-nuts, and oranges.

Mangaia is a larger but less fertile island with a remarkable raised reef like the rim of a felt hat, about a mile wide, along which the chief cultivation takes place. These taro swamps are the support of the small villages, but population has declined greatly. *Atui*, *Aitutaki*, and many others are all fertile spots, but the whole group is under-developed. It is specially well suited for the production of tropical fruits and coffee.

5. *The Society Islands* (*Tahiti*)

This cluster of eleven islands is in some respects better known than many of the other more extensive groups, a result doubtless due in part to their position on the outer fringe of the volcanic area. The name that the group bears is another relic of the first great voyage of Captain Cook. It was to these islands that the scientific expedition sent out under his command by the Royal Society came to observe the transit of the planet Venus across the face of the sun in 1769. The old volcanic masses of which the islands are composed have been broken down by rain, sun, and wind into most unusual outlines even for islands of this formation. *Moorea* (see Fig. 89) has razor-back ridges and needle peaks that outdo any alpine range for abruptness and for fantastic skylines. The wonderfully rich soil that is the chief source of the vivid and luxuriant vegetation in the islands is formed by the weathering of these rocks.

The largest island of the group, *Tahiti*, has a shore-line about 120 miles in length, behind which the land rises to a central block fringed like a tiara and known as the Diadem. Into this central mass deep valleys have been torn by the descending streams, and here is found in profusion almost every plant known in the sub-tropical Pacific. No other group has a more pleasant or more equable climate, and Cook's own appreciation of the land may be quoted:

'Perhaps there is scarcely a spot in the universe that affords a more luxuriant prospect than the south-east part of Otaheite. The hills are high and steep, and in many places craggy; but they are covered to the very summit with trees and shrubs, in such a manner that the spectator can scarcely help thinking that the very rocks possess the property of producing and supporting their verdant clothing . . . and that no place on earth can outdo this in the strength and beauty of vegetation.' (*Voyages*.)

The other islands are neither so large nor so suited for

settlement, but they are, nevertheless, all very fertile. The chief of them are *Mehetia*, *Moorea*, *Huahine*, *Raiatea*, and *Borabora*; but all, with the exception of Huahine, lack good harbours. The whole group is administered as a French dependency. *Tahiti* itself has a mixed population of about 10,000 people. Perhaps no Pacific islanders show the effects of the impact of 'civilization' so sadly as the people of this group. Originally a splendidly developed and capable race, they have deteriorated greatly through the effects of diseases and vices introduced by the new-comers. Their recovery has not been assisted by the introduction of Chinese, who now, through their hold on the trade of the islands, largely control the fortunes of the natives.

Papeete, beautifully placed upon a reef-protected harbour, is the chief port and centre of administration. As the first island of any importance on the route from San Francisco to Australia the port is a regular place of call for mail steamers. Since the occupations of the people are wholly agricultural, coco-nuts, taro, oranges, sugar, vanilla-beans are all produced in some quantity, but very little systematic planting has taken place.

Phosphates (80,000 tons) and copra are the chief exports.

6. *The Hawaiian Islands*

Almost midway between Asia and America along the Tropic of Cancer and 'extending in a curve from north-west to south-east, there is an elongated submarine platform nearly 2,000 miles long, presumably built up by submarine lava flows' (Freeman). Parts of this plateau, however, rise above the ocean surface. At the northern end a few scattered peaks, of which Midway Island is one, rise from the water; and a similar group occurs at about the centre. For the greater part these are uninhabited and useless; but, at the southern end, the platform has been heaved above the water in a series of great lava domes that now form the Hawaiian Islands.

Volcanic activity is still prominent in *Hawaii*, the largest, highest, and most southerly of the group, which consists of eight large islands and a number of smaller rocky peaks. The average elevation of the group is over a thousand feet, while Mauna Loa on the island of Hawaii rises to a summit nearly 14,000 feet above the sea. The eight inhabited islands cover

FIG. 94. SUGAR GROWING IN HAWAII

An aqueduct or 'flume' is used for floating cane to the mill

about 7,000 square miles, and the group forms a 'territory' under the government of the United States. *Oahu*, towards the centre of the group, with half the population of the islands, is economically the most important.

Like Fiji, Hawaii is in the trade-wind belt, and enjoys a very similar climate. Average temperature throughout the year is between 70° and 72°, and there is only a difference of 5°–8° between the averages of the warmest and the coolest months. The chief variation in temperature in the islands is due to elevation, and both Mauna Loa and Mauna Kea are snow-capped at times. The constant winds from the north-east have a high moisture content; and, as the main trend of

the islands is at right angles to the wind-direction, both islands have pronounced wet and dry sides. The rainfall maps for Oahu and Maui bring this out particularly well. On almost

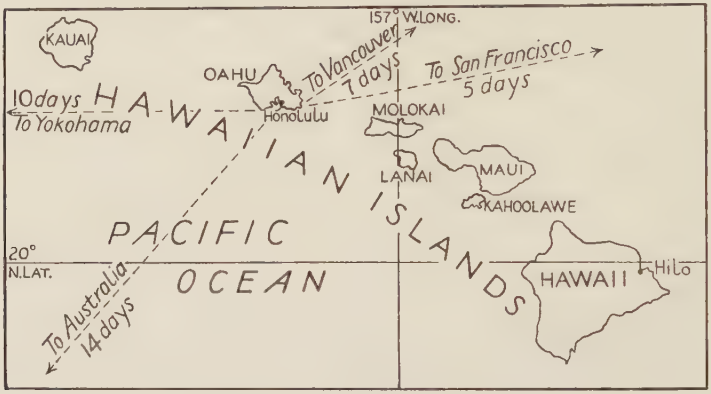

FIG. 95. HAWAIIAN ISLANDS

FIG. 96. RAINFALL, OAHU AND MAUI (after Freeman)

any day the trade-wind moisture can be seen on the windward side of Oahu condensing as it is stopped on the sheer face of the Pali, and wreathing the mountain top in constant cloud as it drenches the cliff walls. Some moisture, carried over to the dry side, falls intermittently as the lightest of misty rains—the 'liquid sunshine' of Honolulu. Although the destructive

hurricanes which occasionally molest the islands to the south do not blow in the Hawaiian Islands, strong cyclonic storms known as 'konas' sometimes reverse the usual order of things and bring rain to the southern slopes. In general the rain tends to fall more in the cooler than in the hotter months.

A marked effect of the lop-sided rainfall is the control which its exerts upon agriculture. As a rule the northerly slopes are too wet for cultivation, and most of the agriculture is carried out on the southerly slopes. To enable the cultivation of the dry side, however, most of the lowland crops have to be irrigated. The underlying basalt layers in these islands are fortunately as porous as a sponge, and they store great quantities of water that become available by boring and pumping. Very expensive schemes for tapping this artesian water, and for bringing water from the wet side through the hills by flumes, pipes, and tunnels, have been carried out. The rivers of the island are short and irregular in flow, and useless for irrigation schemes.

The chief industries turn on the cultivation of sugar-cane and pine-apples. The lowland plains covered for miles in every direction with an unbroken expanse of green canes, and the regular lines of the pine-apple plantations on the higher slopes in the background are the most striking feature of the landscape in the agricultural areas. The cultivation of these two plants is the basis of Hawaiian agriculture, as the refining of the sugar and the canning of the pine-apple are the chief secondary industries. Plantation methods have been very highly developed, and the efficiency of the two main industries, from the raising of the best sugar-cane and pine-apple types, through the methods of cultivation and the fighting of diseases and pests, to the cutting, handling, transporting, and the final stages of refining or canning, has set the standard for the world. Nearly a million tons of sugar are exported every year, mainly to the United States; and this crop is almost wholly produced on four islands, viz. *Hawaii*, 279,000,

Oahu, 214,000, *Maui*, 159,000, and *Kauai*, 136,000 tons. Most of the plantations have their own crushing and refining mills; altogether in the islands there are 47 plantations and 43 sugar-mills.

Sugar-planting on a large scale is limited by the available water. A single large plantation will drink a hundred million gallons of water in a day; or four times the average summer-day consumption of a city like Melbourne or Sydney. Every ton of sugar produced requires the provision of not less than 4,000 tons of water. Pine-apples, on the other hand, favour the drier slopes; and 20 to 30 inches of rain will suffice for their growth. The cultivation of the pine-apple is, therefore, the natural means of utilizing the steeper and rougher hill-sides that are difficult to irrigate and reap. The smaller islands where the surface is very irregular can also be used in this way.

Pine-apples in Hawaii are second in importance only to sugar, and the export is valued at about £7,000,000 per annum. Like the famous pigs of Chicago, there is nothing left to go to waste after the pine-apples have passed through the factory: even the prickly rind becomes a cattle-food. And the waste from the crushed sugar-cane is used as a fuel or as a rough paper to spread between the rows of pine-apples to discourage weeds. Other crops of importance, but coming a long way behind these two, are rice and taro on the swampy flats, and bananas and coffee on the better-drained slopes, with a host of other cultivated plants such as paw-paw, coco-nuts, sisal, tobacco, and citrus fruits.

The Hawaiians are a true Polynesian type very closely allied to the Maori and Samoan. All three display the same characteristics, such as splendid physique and skill as fighters and sailors, generosity, and love of music and pleasure. The natives of Hawaii have adopted western ideas as successfully as the Maoris have, and are usually well-educated and excellent talkers and singers. As distinct from the Papuan and

Fijian they have straight hair. Such a number of racial strains have, however, been introduced into Hawaii in connexion with the agricultural activities that Japanese, Chinese, Koreans, Filipinos, Samoans, negroes, and Portuguese and other white stocks mingle inextricably in the business and social life of the island.

FIG. 97. PINE-APPLE GROWING IN HAWAII

The zebra-like stripes on the hill-sides are the strips of *bagasse*—a coarse paper made from the sugar-mill 'trash'. The pines are planted in holes punched in the paper, which conserves moisture and keeps down weeds

Honolulu, as the most completely equipped port in the mid-Pacific, has become the cross-roads, so to speak, where the routes from Asia to America and from New Zealand to Canada meet. It is, in addition, heavily fortified; and eight miles away is the splendid natural basin of *Pearl Harbour*, perhaps the strongest naval base in the north Pacific. As centre of the sugar and pine-apple industries Honolulu has developed an important trade; and, in addition, it has acquired a reputation for holiday-making that attracts numbers of tourists. The territorial government centres in the city, and several important institutions established here

are making a special study of the problems of the Pacific. *Hilo*, the port of the island of Hawaii, and second in order of trade, has no natural harbour. An expensive breakwater now protects shipping. Hilo is the gateway to the volcanic region; and *Kilauea*, the world's greatest active volcano, is thirty miles away. The last portion of the road crosses the old lava floor of the main crater, and passes by the edge of the great lake of fire, where an observation station is maintained by the Government for the purpose of studying the varying phases of volcanic activity. *Haleakala* on the island of Maui presents a contrast since it is extinct. With a crater 20 miles across and 2,500 feet down to the main floor, with its myriad cinder cones 600–800 feet in height, and with the crater rim 10,000 feet above the level of the ocean, it is really a giant among volcanoes. *Kahalui* is the chief port of the island of Maui: like all the other ports except Pearl Harbour, it is mainly artificial.

7. *The Pelew and Caroline Islands*

Lying about 700 miles to the north, and roughly parallel to the New Guinea–Solomons line, is a chain of island clusters about 1,600 miles in extreme length from east to west. For the greater part volcanic, they become smaller and more coralline in character towards the eastern end. Most of the islands are densely wooded. Politically these islands, together with the Marshall group, form one unit. Before 1914 they were all German possessions, but they are now governed by Japan under mandate from the League of Nations. Each of the groups deserves brief individual notice.

(i) *The Pelew Islands.* This is the most westerly group and comprises about 200 islands, of which *Babelthuap* is the largest, and also the most productive. A neighbouring island, *Angaur*, has important phosphate deposits, and the chief exports other than this are copra, turtle-shell, and bêche-de-mer. The typical trade-wind climate enables tropical fruits

to be grown extensively. The population is about one-tenth of the earlier total of 50,000.

(ii) *The Carolines*. This group of 400 islands is arranged in clusters like the bunches on a vine. The *Yap*, *Ponape*, *Mortlock* and *Kusaie* sub-groups are the most important. Very little need be said since the life and occupations in these islands follow very closely along the lines already sketched for other groups. But *Ponape* and *Lele* have more than usual interest on account of the ruined cities left by a former civilization. That on the island of Ponape because of its situation, with the sea ebbing and flowing in its deserted streets, has been called the 'Venice of the Pacific'. The massive stone foundations that still stand like long sea-walls show clearly the plan of this mystery city of the north Pacific.

Something further should be said of the rocky but productive island of Yap, which lies about 300 miles to the north-east. Because of its situation within striking distance of both Japan and the Philippines the island is the subject of a special treaty between Japan and the United States in which Japan concedes free access to the cable and other facilities. The islands of this sub-group have proved wonderfully productive; and here, too, are found the relics of a highly developed people in the shape of buildings and roads upon the origin of which research has so far thrown very little light. *Kusaie* is a mountainous and fertile island of which the chief port is *Lele*, a splendid harbour and notable for the colossal remains of ancient buildings.

8. *The Ladrones or Marianne Islands*

The transition from the volcanic to the coralline formations is shown very clearly in this group which extends along the edge of the volcanic belt. Arranged in a north-to-south festoon, rather than in a cluster, the score of islands comprising the group taper in size from *Guam*, the most southerly member. They are all ringed with reefs, and some of the

northerly islands are merely the summits of active volcanoes. The basalt soil is being carried down on to the reefs so that the cultivated parts of the islands are a mere layer of clay on top of coral limestone.

The people exhibit a considerable mixture of native, Chinese, and Japanese strains; and the natives themselves seem to be part Filipino and part Spanish. Estimates of the population made in 1670 placed the number at about 100,000; but so serious did the contact with other races prove that within fifty years under 1,000 remained. The chief products of the islands are copra and fruit, mostly exported from *Apra*, the port of Guam which is a dependency of the United States.

9. *The Marquesas Islands*

This group lies north of the Tuamotu Islands, and about 1,000 miles distant. Volcanic and rugged, the peaks rise to more than 3,000 feet. The islands form an exception in that there is a complete absence of coral reefs. They constitute a French possession, and the tragedy of depopulation has reached its climax here. A beautiful and fertile homeland that half a century ago supported a magnificent race of 50,000 people, now shelters less than a tenth of that number. *Nukuhiva* and *Hiva-oa* are the chief islands, the ports of which are *Tai-o-hae* and *Atuona*.

Chapter XX

ATOLLS AND OTHER ISLANDS: MICRONESIA

Nothing about the Pacific captures the imagination of youth and age so readily as the desert island of fiction—the atoll in actual fact. And equally nothing is more disappointing in the reality of closer acquaintance. No more

monotonous life or restricted outlook can be imagined than that on those sandy shelves perched just above the level of the surf. An element of excitement which is not so attractive on the spot is added by the chance of being swept into the deep by tidal wave or hurricane at any time. The origin and general formation of the atoll has already been sketched, but there is perhaps need for more colour in the picture. Atolls consist usually of

'coral belts, frequently not more than a mile wide, or even less, of a circular, oval or even triangular form, enclosing in the majority of cases a central lagoon with an entrance on the side opposite to the direction of the prevailing trade wind. These passages are in some instances navigable for vessels of large tonnage; in others they consist of a mere depression in the surface of the reef sufficient to enable the natives to paddle their fishing canoes in and out of the lagoon at high tide. The lagoons themselves are generally shallow though in some places they exhibit vast hollows with an apparent depth of 50 or more fathoms. Their appearance is most extraordinary and beautiful; the water, from the absence of the debris of streams or any kind of alluvium, exhibits so surprising a transparency that an object of the size of a man's hand may in calm weather be distinctly seen at a depth of 60 fathoms. The aspect of the bottom is that of a wilderness of marine vegetation of the most wonderful forms and gorgeous colours, seeming in some places to be spread over the surfaces of the sloping hills, in others to be growing out from the sides of tall pillars or towers, pierced with vast caves in which the refracted beams of the sunshine cause the water to glow with the colours of the opal, and the innumerable species of zoophytes to glisten like gems, while between the huge caverned masses are wide spaces floored with sand, perfectly level and white as snow upon which the great green mounds covered with coral trees throw fantastic shadows so that in leaning over the side of the canoe one cannot escape being reminded of the fabled grove of Aladdin.'

And in and out, up and down the waterways of the submarine landscape thus painted by Stevenson hover and swim and

dart the fantastic shapes and indescribable colours of the finny inhabitants.

But not for us the environment of the mermaid. The life on the sandy stretches above this fairyland concerns us more nearly. As R. L. Stevenson describes it in *In the South Seas*, 'the atoll is a discomfortable home. There are some, and these probably ancient, where a deep soil has formed and the most

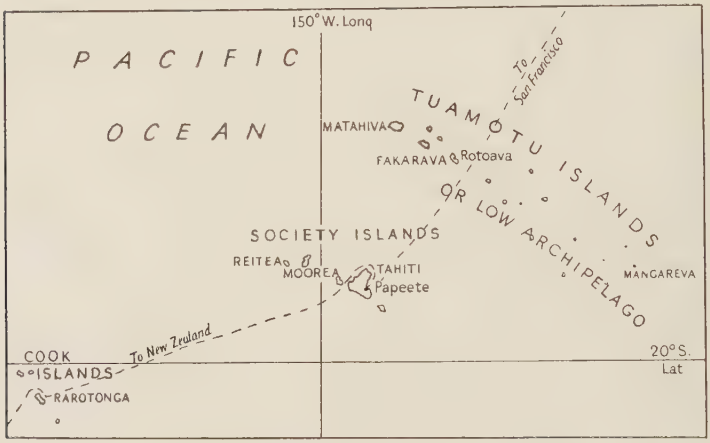

FIG. 98. TAHITI AND THE ATOLLS

valuable fruit-trees prosper. I have walked in one, with equal admiration and surprise, through a forest of huge breadfruits, eating bananas and stumbling among taro as I went. This was in the atoll of *Namorik* in the Marshall group, and stands alone in my experience. To give the opposite extreme, which is yet far more near the average, I will describe the soil and productions of *Fakarava*. The surface of that narrow strip is for the more part of broken coral limestone, like volcanic clinkers, and excruciating to the naked foot. . . . Here and there you come upon a bank of sand, exceeding fine and white, and these parts are the least productive. The plants (such as they are) spring from and love the broken coral, whence they grow with that wonderful verdancy that makes the beauty of the atoll from the sea. The

coco-palm in particular luxuriates in that stern *solum*, striking down his roots to the brackish, percolated water, and bearing his green head in the wind with every evidence of health and pleasure. The pandanus comes next in importance, being also a food tree; and he, too, does bravely. . . . A green bush called "miki" runs everywhere . . . the whole number of plants on an atoll such as Fakarava will scarce exceed, even if it reaches to, one score. Not a blade of grass appears; not a grain of humus, save when a sack or two has been imported to make the semblance of a garden. . . . The land crab may be seen scuttling to his hole, and at night the rats besiege the houses and the artificial gardens. The crab is good eating; possibly so is the rat; I have not tried. Pandanus fruit is made, in the Gilberts, into an agreeable sweetmeat, such as a man may trifle with at the end of a long dinner; for a substantial meal I have no use for it. The rest of the food supply, in a destitute atoll such as Fakarava, can be summed up in the favourite jest of the Archipelago—coconut beefsteak. Coconut green, coconut ripe, coconut germinated; coconut to eat and coconut to drink; coconut raw and cooked; coconut hot and cold—such is the bill of fare.'

The picture may be disappointing, but Stevenson has painted the sober truth of the monotony of life on the desert isle even in these days of infinite variety in the preparation of tinned foods. For the ship with supplies to spare may not happen to visit it once in a term of years.

1. *The Marshall Islands*

Arranged in a double row between 5° and 15° N. of the equator stretches this group of about fifty islands, none of which is more than 10 feet above the level of the ocean. Scattered over these coral rings are 10,000 natives mainly of Mongolian strains, occupied mainly in growing coco-nuts, pandanus, and breadfruit. Here the atoll formation is found in perfection. *Kwatelene*, a wreath of islets a hundred miles across, probably preserves the outline of some giant crater and is the largest atoll existing. Many of the smaller atolls

P 2
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are a perfect unbroken ring, with no outlet from the enclosed lagoon, so that the tide rises and falls through the underlying coral foundation. Of the pandanus or screw-palm a word may be said because of its importance in the scheme of life upon the atolls. It is almost as useful a tree as the coco-nut palm, and it fills almost every need of the islander. The fruit provides him with food, the wood with timber, the leaves with thatch for his hut or wicker for his basket, and the root a dye for the primitive clothes he, or rather she, wears.

2. *Gilbert and Ellice Groups*

The *Gilberts* sit right on the equator, and are composed of very small atolls of hard coral and scanty limestone soil which, nevertheless, support no less than 25,000 people. The *Ellice Islands*, 400 miles to the south, are a similar group which, however, support only one-seventh of that number. The rainfall of all these islands is very variable and may be anything from 10 to 200 inches in a year. Together with *Ocean Island* and *Nauru* or *Pleasant Island*, which are noted for their phosphate deposits, these islands form a British colony.

3. *The Tuamotu Group*

Often wrongly called the Paumotu Islands, this great group of nearly a hundred islands scattered over more than a thousand miles of the central Pacific is the greatest collection of atolls on the map. Because of the treacherous currents which sweep through the group, currents which change and swerve in a most bewildering fashion, it has deservedly gained the name of the Dangerous Archipelago; and an alternative that needs no explanation is the name of Low Archipelago.

'They are all of similar character and exhibit very great sameness in their features. When they are seen at a distance, which cannot be great on account of their lowness, the aspect is one of surpassing beauty if the dry part of the island or belt be sufficiently covered with trees; but much of this beauty is dispelled on a nearer

approach as the vegetation is usually found to be scanty and wiry.' (P. S. Allen.)

The islands rarely exceed 30 feet above the sea, and the chief plants of importance, as on all atolls, are the coco-nut and pandanus.

The chief industry is that of fishing for pearls and pearl shell, but owing to the danger of exhausting the banks the 'take' is carefully controlled. This legislation does not prevent a considerable amount of illicit fishing. Approximately 500 tons of shell, the 'black-edged Tahiti' of commerce, is exported each year, mainly to London, the chief market.

The Tuamotus are a French dependency governed from Tahiti. *Makatea*, a great bench of coral thrust 350 feet out of the ocean, has a notable phosphate deposit. A southerly group, the *Gambier Islands*, is unusual in this locality for its structure, which is that of exposed portions of a submarine ridge rising to sharp, reef-encircled peaks. *Mangareva* is the chief of the group, while *Fakarava* is the largest island in the northern section.

Note.—The two extracts from the works of R. L. Stevenson on pp. 209–11 are reprinted by kind permission of Mr. Lloyd Osbourne.

BIBLIOGRAPHY TO PART V

Allen, P. S. *Handbook of the Pacific Islands*, 1922. (McCarron, Stewart, Sydney.)

Chapple, W. A. *Fiji: Its Problems and Resources*, 1919.

Freeman, Otis. *Economic Geography of Hawaii*, 1927. (University of Hawaii.)

Chapman, Everett A. *Hawaii: Its Resources and Trade*, 1927. U.S.A. Trade Bulletin Information, No. 473.

Handbook of Western Samoa, 1925.

Foreign Office Handbooks:
No. 144, *British Possessions in Oceania.*
No. 146, *Former German Possessions in Oceania.*
No. 147, *New Hebrides.*

Thomson, B. *The Western Pacific* (*Fiji, Tonga, and Papua*) in vol. v of the Oxford Survey of the British Empire. (Clarendon Press.)

Stevenson, R. L. *In the South Seas.*

PART VI
ASIA

Chapter XXI
THE PHILIPPINE ISLANDS

This big group occupies such an important position in the north Pacific that it calls for more special treatment. Situated between 5° and 21° north of the equator, it comprises a rich and undeveloped area capable of producing every tropical commodity, and for this reason of special importance to the United States, under which it is governed since the war with Spain in 1896. Secondly, it is a much under-populated area lying close to the greatly congested countries of Japan, China, and India. Again, its position with respect to Japan, China, and Australia gives it a high strategic importance, more particularly in naval matters. Lastly, the racial and religious mixture which is found in the group makes it one of the 'areas of ferment' in the Pacific; and for this and other reasons the Philippines cannot be lightly passed over.

The three thousand islands of the group cover an area of about 120,000 square miles, or approximately the same as that of the British Isles. Only about one-third of these, however, are habitable; the rest being mere rock peaks affording no foothold for humanity. Just a dozen of the islands, of which the two chief are *Luzon* and *Mindinao*, hold over 90 per cent. of the population of the group.

Geologically the islands are part of the Asiatic land-mass detached by that great subsidence which was mentioned in an earlier chapter. Following or accompanying this sinking there occurred a period of intense volcanic activity which is still vigorous; and most of the land now above sea-level is

highly volcanic in formation. Many active volcanoes still function and in some cases are close to settled areas, while two have broken into violent eruption in the last fifty years.

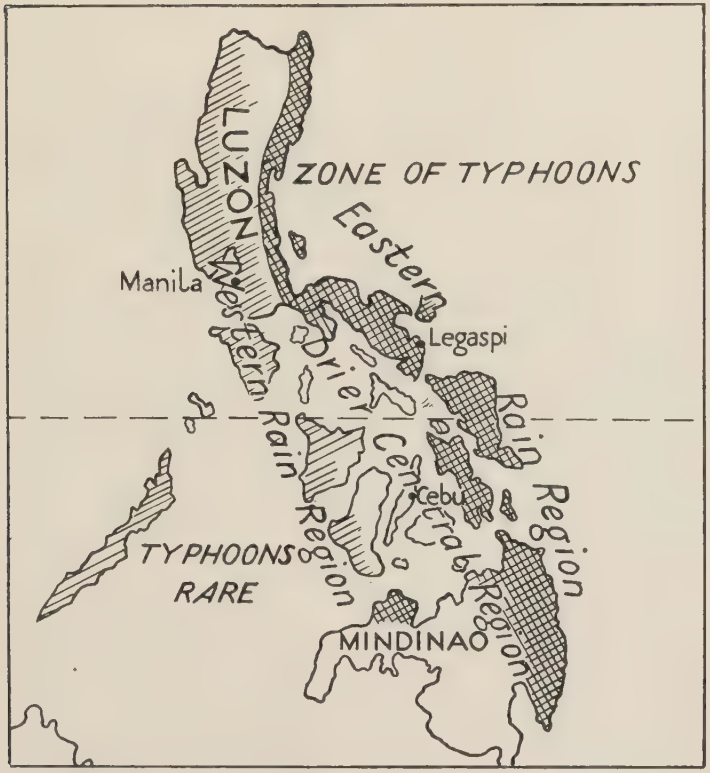


FIG. 99. RAINFALL OF THE PHILIPPINE ISLANDS

Naturally the whole group is subject to severe earthquakes. The trend of the mountain system is mainly north-south; and, although the surface is extremely rugged, few of the peaks exceed 8,000 feet. The larger islands have important rivers, a few of which are over 300 miles in length and navi-

gable for a great part of their courses. The valleys, largely of silt formation, are very fertile, a fact which does much to explain the distribution of people through the group.

Climatic regions are not nearly so definite as on the mainland, or in the neighbouring large islands; but the chief influence is of course the monsoon system. The average monthly temperature varies very little throughout the group, and ranges from about 78 to 84 degrees. Three rainfall regions can be broadly marked, and these exercise a most important control over the agricultural conditions: (i) the eastern side of the group which is exposed to the full effects of the north-easterly circulation, and consequently receives the heaviest rainfall, concentrated mainly in the cool months, November–March; (ii) the western side which gets the full effect of the modified south-west monsoon, with the heaviest fall in the hot season, April–October; (iii) the middle regions between these two areas, partaking of the overlap of both, but getting much less than either on account of their sheltered position. In addition, and modifying very greatly the clear-cut divisions here drawn, the group is much subject to violent cyclonic storms which are likely to cause heavy falls in any locality at almost any time of the year.

The agriculture which is characteristic of the islands follows these rainfall regions very closely; but of the total area only about one-tenth is cultivated, although three times that area is capable of intensive development. Half the surface is still covered with forest, the remaining 40 per cent. being grassland, mainly in the drier areas.

Rice is grown everywhere throughout the group. The soil is so fertile in places and the rainfall conditions so favourable that two and three crops are often taken off the same land in the course of a year. Despite this, and partly owing to the primitive methods of irrigation employed by the natives, the islands do not produce sufficient rice for the needs of the people, and this grain forms the chief import. The chief

reason, however, is the anxiety of the farmer to produce money crops such as sugar, abaca, copra, and tobacco. Still, rice is the most important crop, and maize is also largely grown, especially in the smaller central islands such as Cebu.

Abaca, the stringy fibre of a species of banana native to the Philippines, finds the most favourable conditions on the

FIG. 100. PLANTATION OF MANILA HEMP (*ABACA*)
A two-year-old plantation in the state of British North Borneo. Hemp-growing is one of the staple industries of tropical lands

rainy west side. This fibre is especially valuable for rope-making on account of its durability and strength. The best fibre is from 10 to 13 feet long; and has a particular importance for wheat countries as the chief fibre in binder twine. The plant is grown both under plantation conditions and in the 'gardens' of the Filipinos, as the natives in general are called.

From an export point of view, and if all its products are counted in the total, the coco-nut forms the most important crop. It is the natural crop for the narrow coastal plains, and

the growing modern demand caused by the various uses, from butter substitute to cattle food, maintains a steady market. It would be still more important in the Philippines if care were taken with the preparation of the copra and the oil, but in this as in other industries the Filipino simply cannot be induced to take the trouble necessary to produce the better quality. This is also seen in the case of sugar. Considerable areas in the west and centre are the natural home of the cane, and both sugar and molasses figure very largely in the list of exports. But the primitive methods of production are in sharp contrast to those employed in Hawaii, Queensland, and Fiji. The crushing in many districts is still done by means of long wooden rollers moved by cattle, and the 'refining' in some districts is carried on in iron kettles in the open air.

To the north of Luzon is a valley region where the silt deposits have built up a soil bed under climatic conditions that are most suitable to the production of tobacco, which has become a main crop in many of the smaller islands also. The quality of the leaf has become famous all over the world, and is particularly used in the manufacture of cigars. Many, indeed most, tropical products are grown somewhere in the islands, but the four mentioned, viz. sugar, abaca, copra (with coco-nut oil), and tobacco, are those in which the group has attained importance as a producer.

Economically the mountain region is almost of no importance at present. The forests which are both rich and extensive are the chief potential wealth; but, up to the present, very little has been done to develop them in a careful and scientific manner. In certain mountain districts of Luzon, however, remarkable work has been done by the natives in terracing the mountain slopes. The stone walls holding the soil in place are estimated to be over 12,000 miles in length, and to have taken twelve to fifteen centuries to construct. By this means every drop of the rainfall is utilized, for even in the

rainy season there is little run-off. Besides this the soil is held in place and is prevented from washing down the water-courses. In care of soil beds and in water conservation this supposedly savage people has a remarkable lesson to teach to many of the white farmers in the lands around the Pacific.

Approximately half of the 12 millions of people in the group live on the large northern island of Luzon. For this its size and fertility are responsible. The remaining inhabitants are scattered over Mindinao and a few other of the larger islands. Racially, the people, or rather peoples, of the group present an extraordinary mixture. Although the majority are of the same origin and are termed broadly Filipinos, many sections of the people would refuse to accept that classification. There are three distinct racial stocks in the group, viz. Malay, Mongolian, and Negrito, but in the last few hundred years there has also been a large infusion of Spanish and Chinese blood. More than a score of different languages and dialects have been written, and many more are only spoken as yet. One authority distinguishes eighty-eight, and the main groups differ as widely as French and German. Added to this confusion are the religious differences. Of the population $8\frac{1}{2}$ millions, mainly in Luzon, profess Christianity, and these may be regarded in general as the Filipinos. Another half million, the Moros of the south, are adherents of Mohammedanism, while three-quarters of a million are classed as pagans or savages, such as the head-hunting Igorots. The aboriginal negritos are wild hill-tribes closely allied to the Australian aboriginal. Add to these 50,000 Chinese in whose hands is the greater part of the trade, 8,000 Japanese, and several thousand whites, and the result is a medley with which few countries in the world can compare. The Japanese element, although comparatively small at present, is growing very rapidly.

Manila, the chief port and the historical capital, is a modern city of 300,000 people. With its two miles of breakwater,

steel piers, and handling facilities, it constitutes one of the few first-class ports in this area of the Pacific. More than 70 per cent. of the trade of the group is carried on through the port, which is the one possible rival of Hong Kong.

Cebu with a deep and well-protected harbour is the chief port of the centre of the group, with a growing trade in the products of the region.

Legaspi is the chief port of the abaca-producing area on the east side; but the chief difficulty connected with its development, as with that of the other outports, is the lack of transport facilities both by land and sea.

The actual facts of the trade of the Philippines are given in essence in the following figures for the year 1926. The total exports from the group amounted to a value of £27,000,000. Of this coco-nut products made up 30 per cent.; and sugar, 23·5 per cent., was followed closely by abaca with 23·3 per cent. The chief imports were cotton goods, metals and metal manufactures, and motor-cars.

Chapter XXII

SIAM AND INDO-CHINA

Of all the lands facing the Pacific that great peninsula between India and China known variously as Further India, or Indo-China, is perhaps the least known. And yet, especially from the aspect of human geography, very few lands have a greater interest for the geographer. The position of the region at the south-east corner of Asia has made it a passage-way for many migrations of the past. Mongols from China, Dravidians from India, Malays from the south-east, pirates, missionaries, and European traders have all invaded the country at one time or another in the last thousand years or so. Not once, but many times, the people in possession

have been pushed aside by new-comers; and civilizations have arisen and decayed, leaving only a few relics overrun by the jungle. The people who at present inhabit the country are thus a complex product of the many racial elements left by these invasions.

The country falls naturally into three divisions, determined mainly by the parallel north–south arrangement of the mountain system. Springing from the knotted mass of highland in South China, many ranges stretch southward like the fingers of a hand between the chain that runs down the west side through the entire length of the Malay Peninsula and even beyond, and the broader chain of the mountains of Annam which curves round close to the east coast. In these ranges many peaks rise to heights of 7,000–8,000 feet, and the arrangement of the highlands has a powerful bearing upon the whole life of the region. The shorter ranges gradually merge into a great basin which is a series of broad valleys falling into the vast flood-plain formed by the Irawadi, Salwin, and Mekong rivers and the innumerable smaller streams that feed these. The plain itself gradually merges into the deltas lying around the mouths of the rivers, a swampy, mangrove-fringed region to the north of the Gulf of Siam.

The foot-hills in the far north form a primitive jungle region inhabited mainly by wild hill-tribes who are the pioneers of the country, conducting a little rude cultivation around the small clearings they are able to carve from the forest, and waging incessant war with the jungle and its denizens. Draining these hills are the countless streams running through rugged gorges, and emerging into broader and less forested areas where cultivation is more prominent. In the southern part of this flood-plain are to be found the great areas of rich alluvial soil upon which the population of the country clusters. This part of the plain is a vast rice-farm between the mountains upon the east and west, and across it the rivers wind

sluggishly before depositing their main burden of silt in the delta region. But not more than a fourth of the entire area is under cultivation, although the provision of irrigation and drainage schemes will undoubtedly support far more people here in the near future. The plains, like the Nile Valley, are

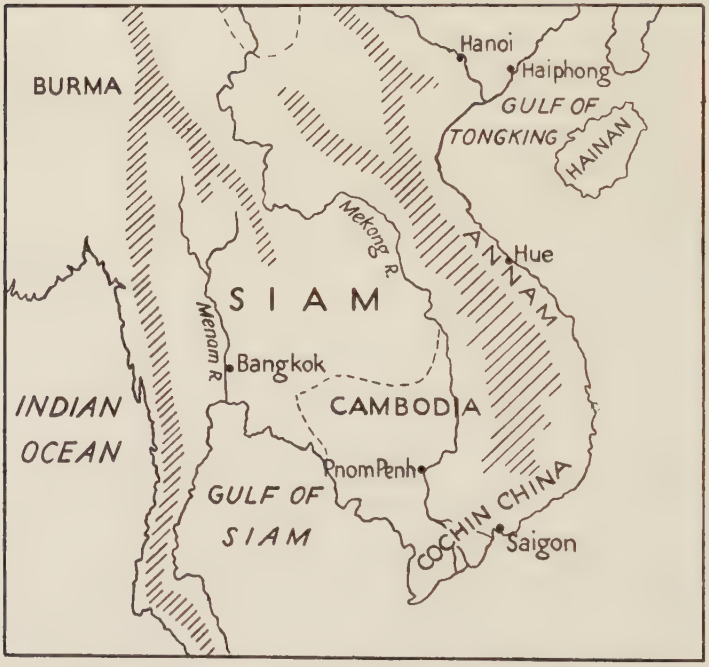


FIG. 101. SIAM AND INDO-CHINA. Highlands shaded

flooded each year after the rains; and the great deposits of silt are slowly raising the level of the country, and pushing the coast-line into the Gulf of Siam at the rate of about a foot a year.

To the east of this plain and under the lee of the Annam Mountains is an area of poorer soil and thinner forest interspersed with huge, useless swamps. In this inhospitable land

live nearly two million people 'wresting from the reluctant soil crops barely sufficient to maintain an existence which, passed amidst damp and mud for one half of the year and in

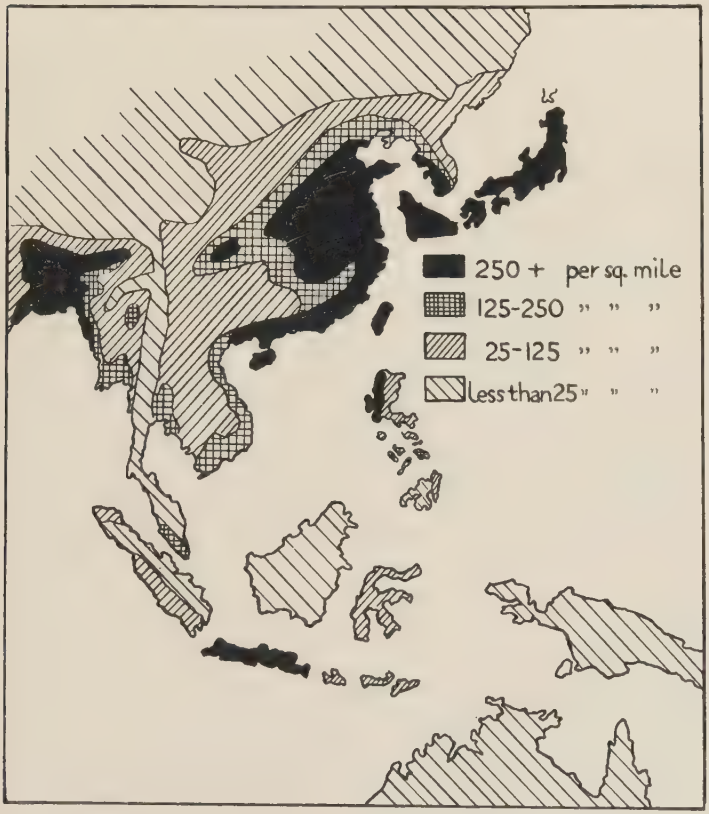


FIG. 102. POPULATION, SOUTH-EAST ASIA

a dry, hot and dust-laden atmosphere for the other, is one of the most miserable imaginable, especially since the neighbourhood is peculiarly liable to epidemic diseases affecting both men and cattle' (W. A. Graham). In sharp contrast to

this are the gentler conditions of the south, where with plenty to eat, an equable climate, and little or no disease, the lot of the natives is of the happiest.

The three great rivers mark out roughly the three political divisions. Burma, with which we shall not deal, lies to the west of the Salwin and the main Kwaa Range. Siam lies approximately between this boundary and the River Mekong, with the exception of the lower basin of that river, which, with all the remaining country to the east, comprises French Indo-China or Annam.

The climate of the whole region is of the true monsoonal type; but there are great variations from the rotation of hot weather—rains—cold weather. Over the alluvial plains in the hot months from March to October the south-west winds bring up the rains from the Gulf, but after October the wind blows from the north-east. Since the whole inland area is sheltered by the Annam Mountains, this season is dry. Over the greater part of the country the rainfall varies from 40 to 100 inches in the year, but most of this falls in 3–5 months. This is, however, sufficient over most of the country for all forms of tropical agriculture, but the main occupation is rice-growing. The whole life of the country turns upon the success or otherwise of the crops, and no other industry except fishing takes such a large share in the activities of the people.

'Rice constitutes almost the sole food of everyone from the lowest to the highest; horses, cattle, dogs, cats and all other domestic animals live on it; it is used for making beer and spirits; it enters largely into all ceremonial, while religious and superstitious observances in connection with its cultivation provide the people with their most frequent occasions for holidays and festivals. The most generally recognised means of investing money is buying, or lending on, rice-fields; the nobles are graded according to the grant of rice-land that goes with their patent of nobility; dealings in rice and the ownership of rice-fields are the cause of most of the

civil litigation in the law-courts; and the result of the last or the prospects of the next crop provide the most absorbing topics of conversation and discussion at all times. It is rice that forms the cargoes of thousands of boats ever passing up and down the rivers; it is rice that feeds the mills of the metropolis and the husks feed the furnaces; it is rice that is carried away in the ocean-going

FIG. 103. RICE NURSERY IN SIAM
Tending the seed beds

steamers always to be seen loading in the ports; it is rice from which the Government derives almost the whole of its revenue.' (Graham.)

This quotation from a writer on Siam might apply closely to any country or island of southern or eastern Asia.

Since the methods of rice cultivation are so similar throughout the Orient a brief description of the most usual processes involved will not be amiss. On the lowlands, or even upon the terraced hill-sides, fields in the shape of flat pans are formed by raising all round a low wall about a foot high. Baked hard in the dry season these fields rapidly absorb the

water when the rains come, and the farmer then sets to work to raise his seedlings in the prepared mud of a corner of one of the fields. When the fields are wet enough they are ploughed, weeded, flooded, and worked up to a consistency of porridge. Then the padi-field is planted by men and women standing knee-deep in mud and water. The young plants are put into the mud in bunches of four or five, and then left until the ripening period approaches, when the chief anxiety is the attacks of birds. As at planting, so at reaping, every one turns out, and with knives and sickles the crop is gathered into sheaves on a prepared patch of ground where it is threshed by cattle treading out the grain. It is then winnowed, and sold on the spot or stored as the farmer decides.

Other crops in this region that are important are the coconut, especially on the lowlands near the coast, rubber, which is still in its infancy, pepper, tobacco, sugar, cotton, and sesamum, a plant alternated with rice and grown for the sake of the oil contained in the seed. Many other plants, of which the principal are beans, betel-nut, cardamom, maize, and hemp, are cultivated in some measure all over the country.

As only one-fourth of the surface is cultivated the great forests, especially in the hilly interior, represent a large and comparatively untouched asset. Timber-getting with the aid of elephants is an important industry in parts, and teak forms the principal item in this industry, although many other timbers are also becoming known and valued.

Fish is the second great staple of diet right through the Orient, and in some form it figures on every menu. Sea-fishing is important all round the coasts of the region especially north of the Gulf, and very curious to Western eyes are the methods used to obtain the catch. In addition the canals and lakes of the lowlands teem with fish, so that the inland areas also have the benefit of 'the double larder' of the land and the water.

Owing to the great extent of the country that is either alluvial plain or jungle very little mining is possible. The mountain regions, however, especially the two main ranges, are rich in mineral deposits. The great granite range that runs down to Singapore is the source of two-thirds of the world's tin, mined mainly in Malaya. But the Siamese

FIG. 104. PLANTING THE RICE SEEDLINGS, SIAM

The planters, women and men, work with almost incredible rapidity; but the hours are long and the work unhealthy

section produces 8,000–9,000 tons each year. Copper is also mined in Siam, while the Tonking area produces coal, zinc, and tin.

The chief centres of the region may now be briefly noticed. *Bangkok*, 20 miles up the Menam estuary, is a city of 350,000 people, built along the canals and river channels. It is the seat of government, which is that of an independent monarchy. *Chieng Mai* (30,000) in northern Siam is the second town, while the ancient capital *Ayuthia* is still a place of importance. *Puket*, on an island off the west coast, has tin mines that are

reputed to be 2,000 years old. The main railway line runs from *Sungai Golok* on the border of British Malaya north to Chieng Mai and is practically the only system in the country. A progressive government is engaged in planning further lines mainly in the productive midlands. The port of *Saigon* is the outlet for the lower basin of the Mekong, although like most delta ports it is not actually situated on the main stream; *Pnom Penh* is the chief town of Cambodia; and both of them are important trading-stations for the French territory in the east. Another lowland area occurs at the head of the Gulf of Tonking, of which *Haiphong* is the chief port, and *Hanoi* the commercial capital and the centre for French rule in Indo-China. As in Malaya and right through the islands, the commerce and much of the plantation country are in the hands of Chinese.

Chapter XXIII

CHINA

1. *The Build of the Country*

The contrast between an island homeland and the conditions of life in a continent is most forcibly presented by the great land-mass of China. That the contrast is a very vivid one in many ways will become clear as that great eastern division of Asia is studied. The chief difference which will be noticed is in regard to human life. While he gains much in culture and industry by having to live closer to other races, man loses in such a continental homeland much of the freedom that island life confers; and he is more open to influences, for good or ill, from neighbouring peoples. This has already been noticed in the case of Siam, but the effects are much more plain in China.

The massiveness of the Chinese homeland makes the

greatest impression on the mind. China proper is a compact unit; and, with the provinces of Mongolia, Turkestan, and Tibet included, has an area twice that of Australia, but containing as many people as there are in the British Empire. It lies, like a half-opened fan, between great mountain ribs nearly 2,000 miles in length, stretching from the Pamir Plateau to Manchuria in one direction, and to the Gulf of Tonking in the other.

Most of the surface is very mountainous, and only along the lower valleys of the great rivers is there any considerable area of low-lying plain. A glance at the sketch showing the grain of the country will tell how very broken is the surface away from the river valleys. The great barriers of the Kuen Lun and allied chains on the north, and the Himalayas and Yunnan Mountains to the south make passage in or out almost impossible, except along the very difficult river gorges; and this has served both to isolate and to defend the Chinese people. (Fig. 106.)

Viewing the land broadly we should notice the major divisions into which it falls, but should realize that within each is a very great variety of surface with which we cannot deal in such a short space. These divisions are (i) the two wide plains in the north-east, which are perhaps the most important area in China if production and trade only are considered; (ii) the tumbled mass of mountain and plateau to the centre and west; and (iii) the comparatively small and isolated, but very important, peninsula of Shan-tung. The most northerly of these two plains is a stretch of about 300 miles in width sloping gently to the Pacific between the latitude of Peking on the north and Hangchow on the south. The second plain area is that comprised by the lower valleys of the Yang-tse river and its tributary Han. The rest of the country is a rugged highland, bisected by the Yang-tse, and rising by high steps to the topmost plateau of Tibet. The northern and southern halves of this great highland

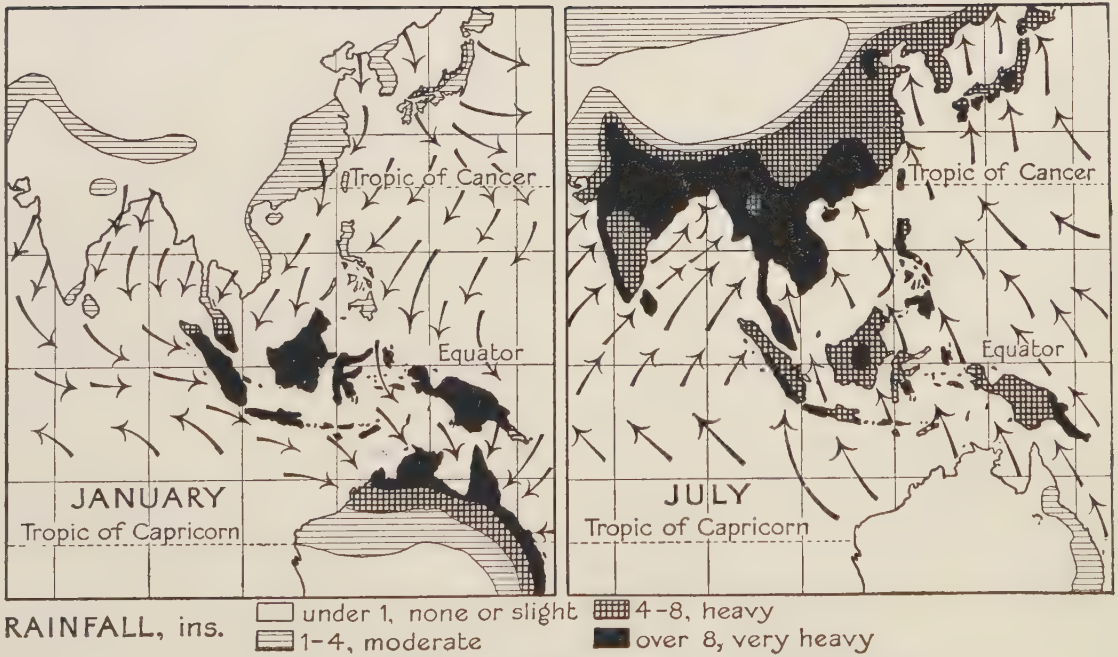


FIG. 105. WINDS AND RAINFALL IN SOUTH-EAST ASIA

region differ very largely in their power to support plant and animal life. In northern China cultivation is possible up to 8,000 feet above the sea, owing to the peculiar soil conditions discussed later; whereas in the south the steep slopes and poorer soils confine agriculture to levels below 2,000 feet. One other region must be noticed in this broad sketch, that of the fertile middle area of the Yang-tse known as the Szechwan or Red Basin. Here, by means of terracing the mountains with the rich red soil of the basin, cultivation has been carried to the very summits. For the rest China is a 'wild and intricate region, scantily populated'.

CLIMATIC DATA FOR SHANGHAI AND ICHANG

	SHANGHAI.			*ICHANG.*	
Month.	*Temp. F.°*	*Wind Direction.*	*Rain. Inches.*	*Temp. F.°*	*Rain. Inches.*
January	37	NW.	2·15	39	0·38
February	39	NW.	2·29	41	1·23
March	46	NE.	3·2	55	4·13
April	56	SE.	3·6	62	3·21
May	64	SE.	3·6	74	3·6
June	75	SE.	6·7	76	5·48
July	80	SE.	5·1	78	8·14
August	80	SE.	5·9	82	6·03
September	72	NE.	4·7	74	5·65
October	63	NE.	3·3	64	0·57
November	52	NW.	1·9	55	0·84
December	42	NW.	1·2	45	0·62
			Total 43·6		Total 39·8

2. *Climate*

The climate of China is entirely governed by the monsoon system, but the very definite effects in the coastal areas fade away inland and to the north. The enormous extent and varied surface of the country, however, produce every kind of climate from 'sixty degrees of frost in Manchuria to the

malaria-ridden swamps of Yunnan'. The Yang-tse valley experiences extremes of temperature from 10° to 110°, and the harsh winter of the plateau regions of the north and west calls for great hardihood on the part of the inhabitants. The variations for typical localities in the more populous areas are

FIG. 106. CHINA AND PROVINCES. Highlands shaded

well worth a little closer study, and the main facts are given in the table on p. 231.

A striking weather feature in the coastal areas is the occurrence about a dozen times each year of typhoons, storms of the hurricane type that have already been noticed in the south Pacific. These winds develop somewhere in the neighbourhood of the Carolines and move westward, causing great havoc especially to shipping.

FIG. 107. 'THE BREATH OF THE MAD TYPHOON'
River shipping driven up by a typhoon in a Chinese estuary

FIG. 108. FARM SCENE IN CHINA
The walls which retain the water within the padi-fields, and the flooded fields, not yet planted, are well shown here. In the front of the temple the young rice is growing, while farther back the gravestones and mounds of the ancestors keep out of cultivation a large part of the farming area

3. *Vegetable and Animal Life*

The vegetation of China must at one time have been extraordinary in its variety and luxuriance. Even now, after centuries of devastation by man, almost every temperate and sub-tropical tree, including both hard and soft woods, every

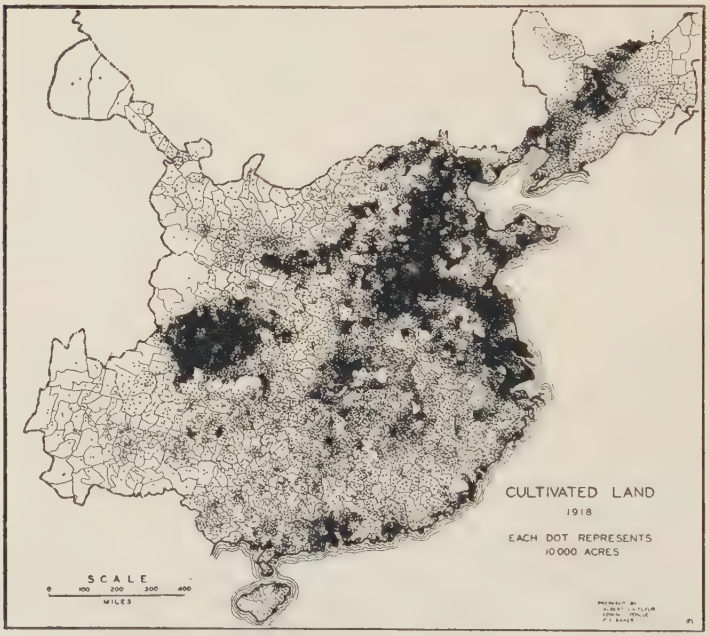


FIG. 109. CULTIVATED LAND IN CHINA

fruit and every cereal, is known and grown. Dense settlement has interfered greatly with the natural vegetation, and deforestation, in particular, is one of the great tragedies of China. Apart from the cultivated plants little natural vegetation now remains over very wide areas; and rich districts have been reduced to deserts. Even the grasses are pulled, roots and all, to serve as fuel in many districts; and the soil thus unpro-

tected is soon swept as useless rubble down the watercourses. The bamboo is the typical plant of the monsoon regions, and means much to the inhabitants of south-eastern Asia.

'With it they build houses and erect temporary shelters; it is used for all scaffolding purposes and for the transport of all goods of human agency, from the smallest market produce to the grand piano in a foreign settlement; when full grown it supplies the vast water population with masts, and from it are made chopsticks, pipes, umbrellas, tables, stools, and musical instruments. When young it is used as food.'

Between forty and sixty varieties are known, and its uses must number thousands.

But the great wealth of plant species cannot be realized. Beautiful and useful trees such as the camphor, ebony, teak, plane, and mahogany; flowering plants which we have appropriated for our gardens such as camellias, azaleas, asters, and chrysanthemums; and a whole range of food plants from tea to millet comprise some of the varied resources of this marvellous country.

Despite this wealth, and the fact that 80 per cent. of China's people are engaged in agriculture, food-stuffs are not produced in sufficient quantity to supply home needs. The great pressure of population has developed methods of agriculture that amaze the world. The careful, intensive cultivation of the Chinese has for centuries included many devices for producing the most from the soil that have only been employed in Europe in the last century-and-a-half. But more than half of the holdings are less than $1\frac{1}{2}$ acres in size, and even much of this is useless because of the desire to maintain untouched the innumerable graves of ancestors.

The destruction of the plant life has also meant the disappearance in large measure of the wonderfully varied animal life. No other continent was originally so rich in animals and birds as Asia, and China was a favoured corner of the continent. Even now the numbers of animals in the mountain

regions must be very great, and no other country supports more animal life of the domestic type, from the pig to the camel, than China. Fish are more than usually important in the scheme of things. The diet of the millions in the plains and along the coast consists largely of rice and fish. The great wealth of fish life in the rivers and lakes is carefully supplemented by the rearing of fish in pools all over the country. The continental shelf of China is also particularly rich in fish life, and the fishing industry is just as important here as it is on the Grand Banks of Newfoundland, or round the Dogger Bank in the North Sea.

4. *The Rivers*

The real China, however, the China of the vast crowded masses, is the land of the great river valleys. The Hoang-ho in the north, the Yang-tse in the centre, and the Si-kiang in the south are the three threads on which hangs the life of the Chinese republic.

North China is for practical purposes the valley of the Hoang-ho. If we take as a dividing line the watershed between this river and the Yang-tse, the provinces to the north are distinct in every particular—climate, crops, character and customs of people—from those of the south. Our line in fact marks the boundary of the true monsoon region, and the northern limit of the rice and the bamboo. To the north these are largely replaced by wheat, millet, and tree timbers, and both people and scenery are stamped by the change. Meat, too, largely replaces fish in the diet of the people; and even the domestic animals are different, the ox and the camel taking up the rôle played by the buffalo farther south. Nature gives more grudgingly, life demands more effort, and this niggardliness of the homeland is reflected in the sturdier minds and bodies of the northern people.

The second factor in the human geography of north China is represented by the queer word, *loess*. This is the name

of the dust blown for centuries from the highlands of Asia down the valley of the Hoang-ho. Here it has piled up thousands of feet deep, covering like a yellow flood all but the higher parts, and forming a loamy soil of wonderful fertility. When the wind blows from the north the air is filled with

FIG. 110. CANAL SCENE ON THE GREAT PLAIN

'Where canals have to be crossed they built dainty hump-backed bridges, with rails and newel posts of an elegance which puts our utilitarian bridges to shame.' (Buxton.) Notice this typical tiled Chinese roof with the curving eaves on the bridge-house, and the different model seen in the distance through the arch

a yellow fog so dense that even shipping off the coast is interrupted. Into this friable mass the streams have cut deeply, and the burden of yellow silt gives its name to the great Yellow River (Hoang-ho) and later to the Yellow Sea where it used to discharge. Roads, too, have been worn down through the soil in canyons 30–50 feet deep. 'Along these roads and out of their vertical walls, the inhabitants have excavated their dwellings—originally simple caves in the loess, now developed

into houses of two and three storeys with wooden doors, window-frames, and staircases, houses warm in winter and cool in summer and marvellously free from damp.' The loess plain of northern China may be a vast inland sea in flood-time, endless miles of growing crop in the summer, or a monotony of bare brown soil in the winter.

FIG. 111. CHINA'S MISSISSIPPI

Shipping on the middle Yang-tse, and a typical landscape in Central China. These boats are the whole family capital, the home and the tools of trade of a great part of the population of 'The River'

Middle China is merely Kiang, '*The River* as the Yang-tse is called by the millions who dwell on its fertile banks or on its broad surface.' Owing to the masses of people crowded into its valley, the river is the main line of trade and communication right into the heart of Asia; and the merchandise carried to the provinces in the basin represents 60 per cent. of the foreign trade of the whole country. Added to this is the importance given by its consistent climate and regular crops. The typical products of the region, rice, silk, tea, and cotton,

are the staples of commerce. In spite of poor coal-supplies these products are the basis of great industries, and the spinning of silk and cotton, the preparation of tea, the making of porcelain and steel, and the production of oil afford occupation for millions. The area of the basin is about 600,000 square miles and supports 180 millions of people.

FIG. 112. 'SHIPPING, BEWARE!'

The *bore* or great tidal wave which periodically scourges the estuaries of south-eastern Asia is particularly dangerous on the Yang-tse

For pressure of population this is rivalled only by the Ganges Valley. The gateways to the provinces of the basin are the great ports of the country such as *Shanghai*, *Chinkiang*, *Wuhu*, *Hankow*, *Changsha*, *Chungking*, and *Ichang*.

In the mountain region the stream is of little use for transport since it falls at one place nearly 7,000 feet in 150 miles. In contrast to this it drops only 500 feet in the last 1,000 miles of its course, and this portion is the main highway of the country. The melting of the snows in Tibet causes great floods, when the river sometimes rises 100 feet in its middle

course. The average volume of water is tremendous, and by its aid the mountains of Asia are being slowly but steadily moved a thousand miles east, and spread over the plains as silt, or dropped into the Pacific. The amount of silt carried out to sea each year is said to be sufficient to build a new island one mile square and 100 feet deep, and that after an equal amount has been spread over the rice-fields of the basin.

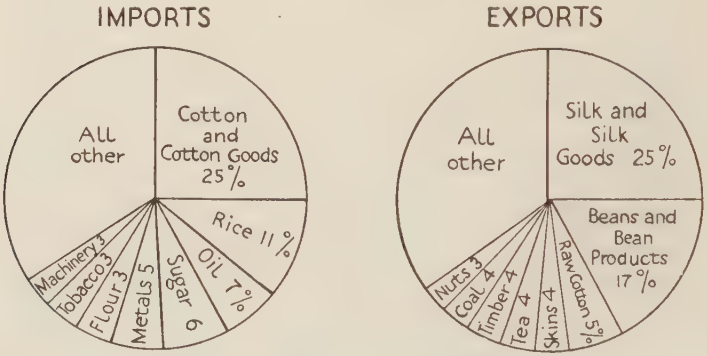


Fig. 113. TRADE OF CHINA

The Si-kiang, although small compared to the Yang-tse, is a mighty river the size of the Murray, and navigable for nearly a thousand miles. In its 390,000 square miles of basin live 60 millions of people. This represents a density of about 150 people per square mile compared with 160 on the Hoang-ho and 420 on the Yang-tse basins. Although the region has a sub-tropical climate the soils are poor, and the pressure of population has forced the people to emigrate. The Cantonese have been called the 'Anglo-Saxons of China' and in search of trade or employment they have penetrated to every corner of the Pacific, from Tasmania to British Columbia.

The outer provinces of Mongolia and Tibet are great plateau regions which are, at the moment, of little economic importance. The difficulties of transport, the harsh climate,

the nomadic character of the people, especially in Mongolia, and the small range of production are the chief features to note. Nevertheless it is probable that Mongolia, in particular, is very much under-developed; and that any expansion of China will undoubtedly take place in that direction. If those provinces are taken into account, China must be regarded as

FIG. 114. TRANSPORT IN CHINA

Industrially China is just emerging from the Middle Ages, and railways or motors have not yet had much effect on methods of transport. The main vehicle is the one-wheeled cart, on which enormous loads are balanced. A smaller barrow has man as the universal beast of burden

being self-contained in a very high degree, especially if the great mineral wealth of the mountain areas be considered.

The Shan-tung Peninsula, largely because of its position with relation to Japan and Manchuria, is an exceedingly important area. Comprising 56,000 square miles of country, mainly mountainous, it is the home of 31,000,000 people; and in respect to cultivation, railways, communications, industries, and mines it forms one of the most highly-developed regions of China. It has very important coal-mines in which Japan is largely interested; and the silk industry has reached its fullest development in the valleys and along the lower slopes of this area.

The importance of Chinese cities is here mainly measured by their trade, but with regard to population and historic importance this is often a most unjust method. The chief gateways are determined by the relief of the country as already described, and position near these gateways or along the main route to one of them is of the highest importance for

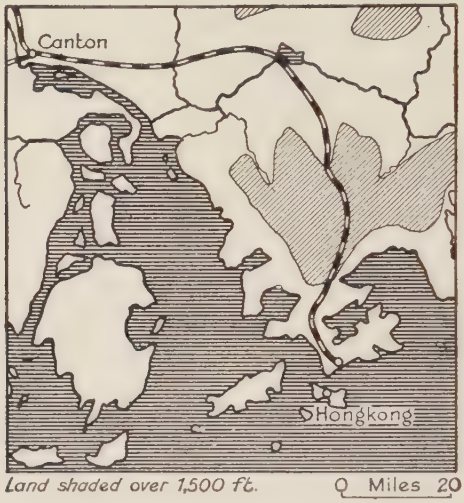


FIG. 115. HONG KONG

trade. *Peking* (1,200,000), the ancient capital on the lowland coast route between Manchuria and the south, is the largest overland trading centre, and was still the capital until recently; and *Tientsin*, the chief port of the region, represents the northern gateway. *Tsing-tao* with its port of *Kiau-chau* are the main outlets for Shantung. *Shanghai* (1,500,000), collecting and distributing point for central China, is the sea-gate for the very productive Yang-tse valley. Originally a concession of swamp on the banks of the Whangpoo, an arm of the Yang-tse, it has been made one of the greatest ports of the Pacific mainly by the energy of British merchants. The river ports

Hankow (1,500,000), the trade capital and largest town; *Nanking* (400,000), which became the centre of Government in 1928; *Chinkiang* (140,000), and *Ichang* (60,000) are all important trading centres with tea and silk as staples. *Foochow* (300,000), *Amoy*, and *Swatow* are coast ports. *Canton* (1,000,000), most progressive and most restless city in

FIG. 116. THE ICE-BOUND COAST OF N.-E. CHINA

Winter scene at Chefoo, a port on the north of the Shantung Peninsula facing Dalny. The edge of the ocean is frozen for a mile out to sea, a serious hindrance to shipping

China, is the southern gateway. *Hong Kong* (625,000), a British possession, is on a small island 11 miles long and about 3 wide which was originally a bare rock rising to about 2,000 feet above sea-level. The splendid harbour has been made the finest port of China and the chief gateway for foreign trade, again by British energy. It is also an important distributing centre for the Pacific islands of the west Pacific and a British naval base. *Chungking* and *Luchow* are the chief cities of the Szechwan Basin.

FIG. 117. MONGOL VILLAGE ON THE STEPPES

A nomad settlement on a caravan route much as it would appear in the days of Kubla Khan. Notice the more permanent felt tents (*yurts*) with their conical tops in the background, and the ridge-pole tents which can be set up very quickly and just as quickly taken down and packed on the backs of camels

CHAPTER XXIV

MANCHURIA, MONGOLIA, TIBET, SIBERIA

1. *Manchuria*

PHYSICALLY this region may be described as an extensive uneven plain sloping generally towards the Yellow Sea or its northern gulfs, and enclosed by high mountain ranges on the east and west. It is a region of great importance because of its position on the frontiers of China, Russia, and Japan. This political situation has served to retard rather than to advance development, although, since the construction of railways across the region, progress has been more rapid. Soils are good everywhere, and the climate not more

rigorous than that of northern Europe. The chief difficulty for settlement is that of agricultural water-supplies; but there is no reason, if extensive irrigation schemes are undertaken, why Manchuria should not become very productive.

For the reasons already given Manchuria is not densely populated, but a considerable influx of Chinese settlers has taken place in recent years. The climate is such that the cultivation of almost every temperate climate cereal is possible, and there is a considerable export of food-stuffs to China consisting mainly of soya beans and bean products, millet, and wheat. Since the occupation of Korea after the war with Russia the Japanese have been energetically extending their influence into Manchuria. Railways, harbour works, roads, and flour-mills have been constructed; and the interest taken in the region is mainly due to the Japanese need for food-stuffs, timber, minerals, and an area for colonization to absorb the increase of population.

Mukden (250,000) is the capital of the province, and an important railway town. *Harbin* (170,000) is the important junction between the Manchurian railway and the trans-Siberian line. *Dalny*, the port of southern Manchuria and the terminus of an important railway, is ice-free all the year round.

2. *Mongolia*

This is a mountainous region best described as a high-level plateau of no great fertility. A large part of the surface, which covers more than $1\frac{1}{2}$ million square miles, is taken up by the cold desert of Gobi, which constitutes an effective barrier between China and Russia. The northern frontier runs through a very rugged and desolate region. Because of rainfall deficiency the region is a vast natural pasture-land, and the human life of the region is a direct response to these conditions. The natives are nomads, living in tents and moving north and south with the seasons. The harsh continental

climate of these uplands demands great hardiness on their part, and at the same time prevents any agricultural development. Less than two millions of these people are estimated to inhabit this vast territory.

FIG. 118. A MONGOL LADY OF THE STEPPES

Notice the typical features, the warm clothing necessary on these bleak plains, and the felt tent at the wooden door of which she is standing

It is very interesting for another reason. It is believed that this is the region which was the original home of the Mongolian race, and that fertile districts were transformed to deserts by climatic changes, their cities overwhelmed by moving sand, and their peoples driven to emigrate. Many of the invasions of early times, and the Mongolian migrations to the south and across to America, are explained by these changes of climate in prehistoric times.

Mongolia is nominally a Chinese dependency but Russian influence is very strong. *Urga* and *Kalgan* are the chief centres.

3. *Tibet*

This is the highest, largest, and most inaccessible plateau in the world; and is isolated on every side by great mountain rims that make transport almost an impossibility. The least difficult approach is from the Chinese side along the river gorges, and it was in this manner that Tibet became a Chinese province by conquest in very ancient times. The surface of the region is extremely broken, the

climate is one of great severity, and agriculture is almost impossible except in small areas of the sheltered valleys. As a consequence of climate and isolation the people are exceedingly backward, and very hostile to change. The chief feature of the life of the country is the hold obtained over the

FIG. 119. MANCHU AND MONGOL

Within the great similarity presented by the inhabitants of China, there are differences just as notable as those between European peoples

people by the large numbers of Buddhist monks who throng the monasteries of the plateau. The chief of the religious body is also the political head and is known as the Dalai or Grand Lama. His seat is the walled fortress of *Lhasa*, important as a junction of caravan routes.

4. *Siberia*

The immense area known as Siberia drains mainly towards the Arctic, but because of the impossibility of transport moving towards that ice-bound ocean Siberia turns largely

to the Pacific in the economic sense. This movement has been more obvious since the construction of the trans-continental line which traverses the whole width of Siberia from east to west. The political disturbances in Russian life, the difficult nature of the country, and the reputation the region acquired as the chief penal settlement under the Tsars has hindered development. Siberia constitutes, however, one of the great unsettled pioneer belts of the world, an area of high fertility suitable for the occupation of temperate climate peoples.

Allowing for the plateau character of much of the mountain country along the east coast, the country falls into broad divisions that depend largely upon climate. The whole of the region to the southern mountainous edge is exposed to the cold Polar circulation; and, lying as it does across the longest side of the world's greatest land-mass, its climate shows great extremes. The highest summer temperatures and the lowest winter temperatures are recorded for the north-east. *Verkhoyansk* in the Lena Valley is reputed to be the coldest place in the whole world, and temperatures of –80° have been recorded. Rainfall is chiefly in the winter and in the form of snow, which lies till the returning warmth of early summer thaws the whole land. This rainfall tapers towards the interior, but the chief control of vegetation is the intense cold of the long winter. The regions to be distinguished are: (i) The *tundra* or northern plains converted by the warmth of summer from an iron-hard frost-bound waste to a swamp region with flooded streams. (ii) The *taiga* or pine forest belt. This stretches across the country to the south of the tundra into which it gradually merges. It is very low-lying also and in parts almost swamp. The inhabitants are not at all numerous, and lead a very primitive life as dwellers on the forest edge. (iii) The *prairie*, great open plains to the south of the forest where the soil is excellent and the climate quite suitable for agriculture. It resembles very closely the similar

region of Canada. (iv) The *steppe* country, which lies in general still farther south and constitutes a great natural pasture. (v) The better valley regions of the south, where the

FIG. 120. ANCIENT WALL AND MODERN RAILWAY, INNER MONGOLIA

The wall typifies the clash between the Mongolian nomad of the steppes, and the Chinese farmers of the northern river valleys; the railway represents the final victory of the farmer, who is ploughing into the steppe at the rate of a mile a year over a wide front. Notice the treeless and deeply-eroded hill-sides

conditions favour dairy-farming as the main industry. (vi) The very mountainous south, which has great undeveloped mineral resources.

The chief route of the region is the trans-Siberian railway, which terminates at *Vladivostok*, the Pacific gate of eastern Siberia. Unfortunately the harbour, while suitable in all

other respects, is blocked by ice for some months during the winter. The trans-continental line brings to this port the wheat, butter, and animal products of the southern area of Siberia. It actually enters the Pacific Basin when it crosses the Yablonoi Mountains at a height of 3,000 feet above the sea.

FIG. 121. TERMINUS OF SOUTHERN MANCHURIAN RAILWAY, DALNY

Scientists tell us that the soya bean is the solution of the food problem of the future. Japan's dependence upon the mainland is well illustrated in the stacks of bean bags here shown

CHAPTER XXV

THE JAPANESE ISLANDS

1. *Structure and Relief*

THE Japanese Islands extend in two great arcs or loops from Formosa to Saghalien, and number several hundreds. The six large islands are Saghalien, south of 50°, Hokkaido, Honshu, Kiushiu, Shikoku, and Formosa. Of the total area of 148,000 square miles, Honshu alone com-

prises 87,000 or nearly 60 per cent., and Formosa 14,000 or about 9 per cent. Japan proper is a line of folding thrust up along the margin of the Asiatic block. This fold is a line of weakness in the crust, and for this reason the whole area is highly volcanic. Ranges rise to 8,000 feet with isolated peaks rising above them, of which Fuji (12,000) is the highest. As Japan is merely the unsubmerged top of this great fold line, the area of comparatively level land in the islands is very small, and amounts to only one-quarter of the surface area. Three lowland areas are of marked importance, viz. the Kwanto Plain upon which Tokyo and Yokohama stand, the Kanai Plain which holds the large industrial populations of the Kyoto-Osaka district, and the Nobi Plain of which Nagoya is the centre.

On account of the unstable nature of the crust in this region earthquakes are remarkably frequent, and about 1,500 shocks are recorded every year. The Pacific side of the main islands is more susceptible to these disturbances than the inner line. The most destructive shock in the world's history occurred on this side in September 1923, when 91,000 people lost their lives and enormous damage to property occurred. At least fifty active volcanoes are known to exist in the islands, but many more are merely dormant. Hot springs are found everywhere.

2. *Climate*

Japan comes well within the monsoonal area, and thus belongs to the south-eastern Asiatic system. As a result of the influence of this system of air circulation there are, however, two distinct climatic regions, and two wet seasons are the rule. Owing to the relief of the country the 'front' (Pacific) and 'back' (Japan Sea) coastal regions are affected very differently. The north-western monsoon blowing from Asia across the Japan Sea brings much rain and snow to the 'back' region during the cold months September to March.

FIG. 122. JAPAN AND ASIA. Highlands in black

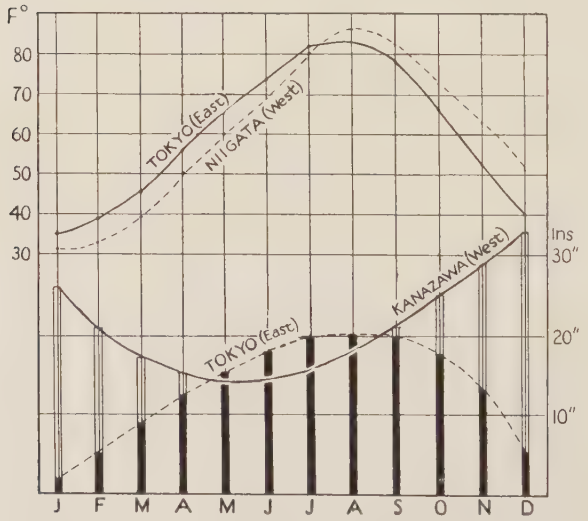


FIG. 123. JAPAN, TEMPERATURE AND RAINFALL

The more extreme continental influences are thus felt on this side, and very heavy falls of snow are common. The south-east monsoon blowing up from the Pacific in the months from April to August brings the main rainfall to the 'front' area, which, in general, has a much milder climate than the other coastal region. It will be seen that the wet seasons on the opposite sides alternate; and reference to the graph will show, first, the warmer winter and cooler summer of the east (Tokyo) side as compared with the west (Niigata) side; and, secondly, the difference in seasonal rain. A fair indication of the change of seasons is given by the direction of the prevailing wind at Hakodate for the twelve months, viz. W., W., W., W., SE., SE., SE., ESE., E., N., W., W. Japan is, however, much subject to cyclonic disturbances both from the northern and tropical areas, and typhoons often cause serious damage from July to October.

The climate of Japan is also strongly influenced by the neighbouring ocean currents. The warm stream known as the Kuro Siwo, which sets along the Pacific coast from the south, is very largely responsible for the remarkably moderate climate and gentler rainfall on that side. The effect of this warm current on rainfall conditions should be contrasted with that of the cold Humboldt Current off the coast of South America. There is an exact parallel to the Humboldt Current in the North Pacific, and this sweeps down from the Arctic along the east shore of Asia, bringing colder conditions as far south as northern Korea.

3. *Vegetation*

Vegetation and agriculture are closely controlled by these climatic influences. The forest areas, in particular, show the general variation from north to south. In the southern area conditions exist that are almost tropical in certain months, and the vegetation typified by the bamboo shows this very

clearly. In the central region sub-tropical conditions induce the growth of characteristic evergreens such as the camphor tree. In the cold temperate conditions farther north, and in the mountain sections, the conifers are most prominent, and these forests are extremely important to Japan. A tree of very great importance in connexion with the silk industry is

FIG. 124. IN A JAPANESE TEA GARDEN

Asia is said to have given us our most perfect drink, tea; our most perfect dress fabric, silk; and our most perfect pottery ware, porcelain

the white mulberry, which finds in Japan very congenial conditions.

So mountainous is Japan that only one-eighth of the whole surface is cultivated. Rice-growing is the chief form of cultivation, and more than half the agricultural area of the country is planted with this grain. The pressure of population upon the farm lands is heavy, and 76 per cent. of farm land is under food-stuffs. Other crops are beans, peas, and barley in the lowlands, and wheat and rye in the uplands. The volcanic soils, especially those of the old craters, such as

Asama, are exceedingly productive. The chief uses of the soil other than these are for the growing of tea, tobacco, and fruit.

4. *Minerals*

In respect of minerals Japan is a comparatively poor country, and affords a great contrast to the countries on the American

FIG. 125. THE HEART OF OLD JAPAN
The Bridge of God, Nikko

side of the Pacific. The mineral resources of the islands are sufficient to provide Japan with her requirements for industry in only one instance, that of copper. Coal, iron, and petroleum are notably deficient. In addition the deposits of both coal and iron are not of the best quality. This poverty in minerals has an exceedingly important effect upon Japan's development, and goes a long way towards explaining her interest in the Asiatic mainland, and particularly in Manchuria and Shantung, where these two minerals are abundant. Coal is found chiefly in Kiushiu and in Hokkaido.

5. *Population*

Japan has at present about 63 millions of people, and the density of population on the lowlands is about 2,500 to the square mile. This means an intensity of cultivation that is scarcely credible in European countries. The average size of

FIG. 126. RECLAIMING THE MAN-MADE DESERT, AICHI, JAPAN

Japan's desperate measures to provide for the needs of a growing population are shown in the re-planting of deforested hill-sides

the Japanese farm, which has to support a typical family of six or seven, is three acres. Every available foot of land has been brought under cultivation, and no effort is spared to bring the land to its utmost production. In about fifty years the population of Japan has doubled, and the yield of rice has been doubled also. But the limit has now been reached, and Japan has to send population abroad, or build up great industries to support them at home as Great Britain has done. A considerable amount of emigration has taken place in the

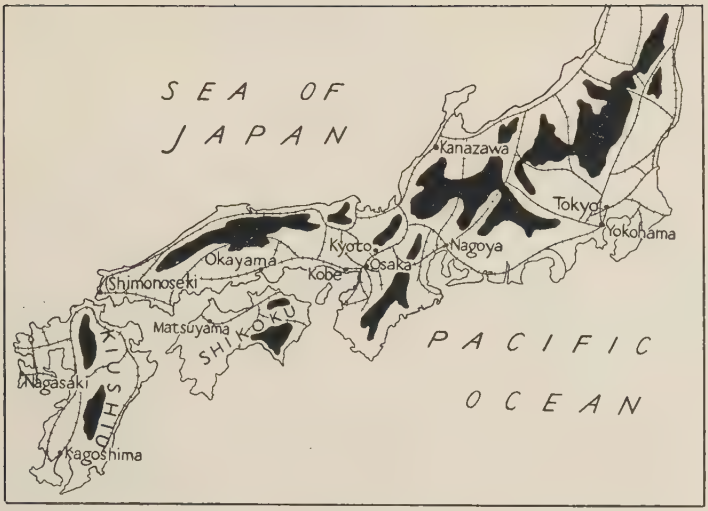


FIG. 127. JAPAN, COMMUNICATIONS AND CITIES
Highlands in black

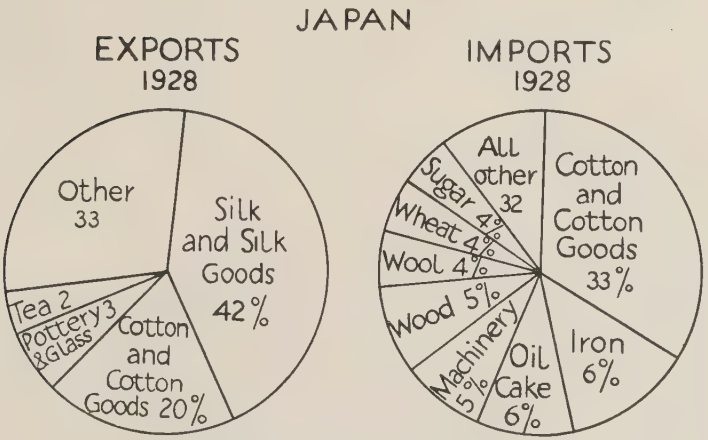


FIG. 128. TRADE OF JAPAN

past to all parts of the Pacific, but particularly to the Philippines, Hawaii, and Manchuria. The great pressure of human beings on the land in Japan accounts for the very small numbers of live stock. Animals are too expensive to keep, except for the necessary farm and transport services.

FIG. 129. SILK FACTORY, JAPAN

Girl workers winding silk from cocoons, Okaya. An example of what the economist calls 'hereditary skill' in an occupation that requires the most delicate sense of touch

A considerable proportion of the people of Japan are 'cultivating the sea' either as fishermen or in the great and increasing fleet of Japanese merchantmen. Fishing is one of the most developed industries in the Japanese islands, as it is right through the Orient, and fish largely takes the place of meat in the diet of the people. The meat substitute, however, is in most cases the wonderful soya bean,[1] which is to the Asiatic all that the coco-nut is to the Polynesian.

[1] The uses of the soya bean are as innumerable as those of the bamboo. It finds its chief use as human or animal food, but it is also becoming

The greatest industries of Japan centre upon silk. Silk-rearing is the industry that enables the Japanese farmer to employ his time during the idle periods on the farm, and it provides employment for every member of the family in tending the worms and cocoons. In the factory it is responsible for a development that has made Japan one of the

FIG. 130. JAPANESE PORCELAIN PAINTER

Despite the coming of the factory system the old artistic spirit of the Japanese craftsman refuses to be crushed

great textile manufacturers of the world. And, lastly, it provides a valuable export which enables Japan to buy so many things that the country lacks. Silk is to Japan all that wool is to Australia. Cotton, woollen, and rayon industries have been established, and Japan's success in these is largely due to the training her people have had for many centuries in the preparation of silk. Many other great industries have

the basis of extensive manufactures. Sauce (*soy*); table vegetable; flour; oil for a hundred purposes from cooking, lighting, and lubricating to the water-proofing of cloth; butter-, coffee-, and milk-substitute; soap and cosmetics; all these do not exhaust the list of articles to which it contributes the chief ingredient.

been established, from shipbuilding to chemical manufacture; and Japan still retains her position as a maker of glass, pottery, porcelain, and lacquer-work.

The principal cities of modern Japan are all in the manufacturing regions. The chief of these regions is the district at the head of the Inland Sea, where, in particular, the great

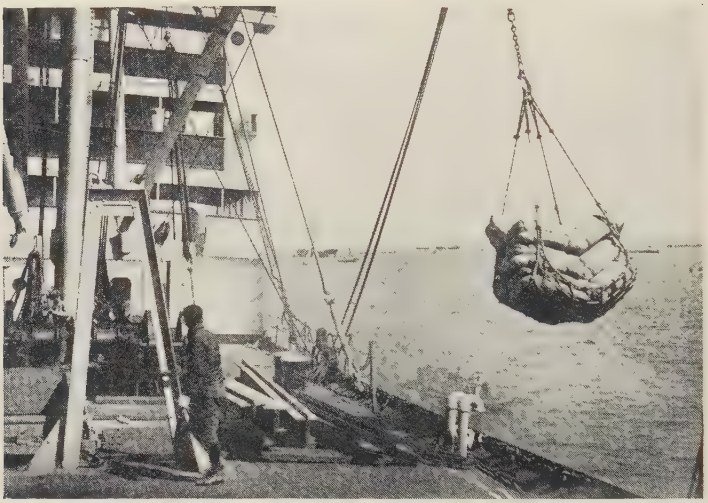


FIG. 131. JAPAN'S STAPLE

Raw silk loading at Yokohama for express delivery to the mills in the east of U.S.A., via Seattle

textile industries are situated. *Osaka* (2,115,000) is the 'Manchester of Japan' and the largest city. Here the textile trade has its head-quarters, and cotton is the chief speciality. Other important industries have been established here. *Kyoto* (679,000), in the same region, is a modern city with textile, chemical, and porcelain manufactures. As the former capital, the city has much historic importance. The port for this region is *Kobe* (644,000), which is now the second port of Japan. The second great manufacturing area lies around

Tokyo (2,000,000), the capital and a large industrial centre. Since the great earthquake Tokyo has been largely remodelled, and takes its place as one of the principal cities in the Pacific Basin in point of population and importance of industry. Its port is *Yokohama* (405,000), which also suffered severely in 1923, but is now a fine modern port protected by

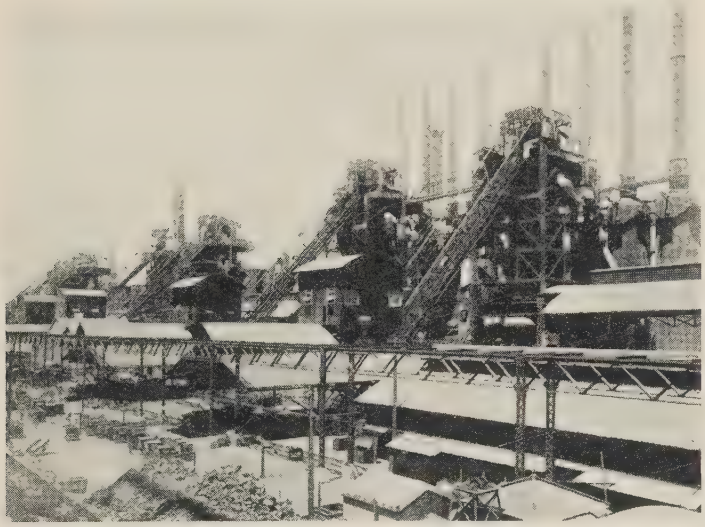


FIG. 132. GOVERNMENT STEEL WORKS, YAWATA

Japan has realized that iron is the foundation of great modern industries

extensive breakwaters, and equipped with modern cargo-handling devices. It is the chief port for the silk trade, most of which is with the United States. *Nagoya* (770,000), an important railway centre and chief town of a silk-producing area, and *Hiroshima*, a port on the Inland Sea, are other cities of the south. *Hakodate* (164,000) is the chief city and port of the island of Hokkaido. *Nagasaki* (189,000) is an important steel-making and shipbuilding centre in Kiushiu. As the

outlet for the coal of the region, and because of its situation, the port has become the chief naval base of Japan.

KOREA AND FORMOSA

1. *Korea* (or Chosen)

This mountainous peninsula is not extremely fertile, but it is inhabited by a very advanced branch of the Mongolian race. Agriculture is at a very high level, but other developments hardly correspond. Korea has been since 1904 a province of Japan, whose tremendous and very successful efforts to modernize the industry and transport of the country are far from being appreciated by the Koreans.

The population numbers about 18,000,000 and is mainly engaged in rice-growing and other branches of agriculture. There is a surplus of food-stuffs, mainly rice and soya beans, and this together with the raw cotton produced here moves through *Fusan*, the railway terminus at the southern end of the peninsula. The ancient capital is *Seoul* (Say-ool), on the western side of the peninsula.

2. *Formosa* (or Taiwan)

This is an island of two distinct regions off the coast of China, to which it formerly belonged. The eastern and smaller section is exceedingly mountainous and thickly forested. It is inhabited by wild aboriginal tribes which give the Japanese government considerable trouble, but the economic importance of the region is very small.

The eastern half is a plain area, well watered and largely composed of sediments washed down from the volcanic mountain areas. The production of rice, sugar, tobacco, and sisal under Japanese control has increased greatly in late years.

FIG. 133. MODERN JAPAN

A cotton factory and its water-power system near Tokyo

BIBLIOGRAPHY TO PART VI

Forbes, W. C. *The Philippine Islands*, 1925. (Houghton Mifflin.)

Mallory, W. H. *China, Land of Famine*, 1927. (Amer. Geog. Soc.)

Bain, H. Foster. *Ores and Industry in the Far East*, 1927. (Council of Foreign Relations, U.S.A.)

Buxton, L. H. D. *China: The Land and the People. A Human Geography.* With a chapter on *Climate* by W. G. Kendrew. 1929. (Clarendon Press.)

Foreign Office Handbooks: No. 68, *Mongolia*; No. 69, *Manchuria*; No. 70, *Tibet*; No. 78, *French Indo-China*; No. 79, *Siam*; No. 73, *Japan.*

Norton, H. K. *The Far Eastern Republic of Siberia*, 1923. (Allen & Unwin.)

Japan Year Book, 1929. (Japan Year Book Office, Tokyo.)

Uyehara, G. E. *Industry and Trade of Japan*, 1927. (King.)

PART VII
NORTH AMERICA

Chapter XXVI
THE NORTH AMERICAN SIDE OF THE PACIFIC BASIN

Any study of the section of North or South America washed by the Pacific must be first and foremost a study of the great plateau region which lies immediately behind the coast for the whole length of both continents. To describe this vast upland region as a series of parallel ranges or as an alpine block would still leave the factors of its height and extent unappreciated, and the description of the great upthrust of the surface through the length of the Rockies and Andes as a plateau region is more in accordance with the facts. In North America two main fold-lines cross over from Asia; one, a continuation across the narrow Bering Strait of the heights of north-east Asia, and the other the much more definite line through the unstable volcanic Aleutian Islands. As the Alaska Mountains this Aleutian fold hugs the curve of the Gulf of Alaska and then breaks off into two lines. That nearer the coast is lower, less clearly marked, and much breached by the sea; but it can be distinguished through the fringe of islands along the coast and lengthwise in the island of Vancouver, whence it continues as a low maritime ridge along the shore-line and right down the length of the peninsula of Lower California. The second line into which the Aleutian fold breaks becomes the bold alpine series known in succession from the north as the Coast Range, the Cascade Range, and the Sierras; the line, in short, which forms the western rim of the plateau area.

The other main fold-line which can be traced from Asia

lies still farther inland; and, becoming much higher south of latitude 60, it swings gradually eastward to form the inside rim of the broad plateau which attains a width of 800 miles behind San Francisco. This tableland is, in general, tilted towards the Pacific; and the streams have had, in consequence, to break through the western wall and, in

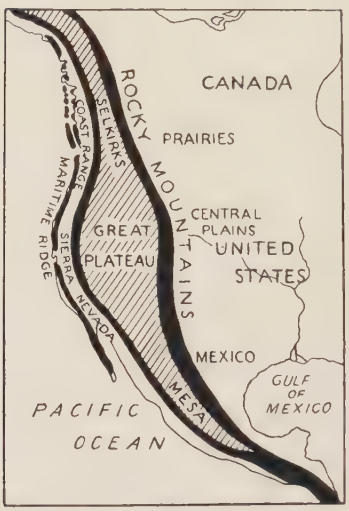


FIG. 134. PHYSICAL

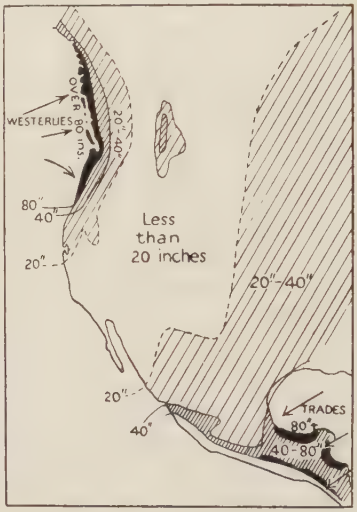


FIG. 135. RAINFALL

NORTH AMERICA

some cases, through the maritime ridge also on their way to the sea.

The chief lowlands along the Pacific coast belong to an almost continuous north-south valley which lies between the maritime ridge and the western wall of the plateau from Vancouver to the Gulf of California. The three major sections of this depression are the Fraser–Columbia–Willamette valleys in the north, the Sacramento San Joaquin valleys in the centre, and the head of the valley, now mostly drowned,

known as the Gulf of California. Economically this last lowland area is of little importance on account of its excessive dryness; but the other two valley regions contain most of the agricultural area, and consequently most of the people of the Pacific side of North America.

Certain features of the great mountain region and of the

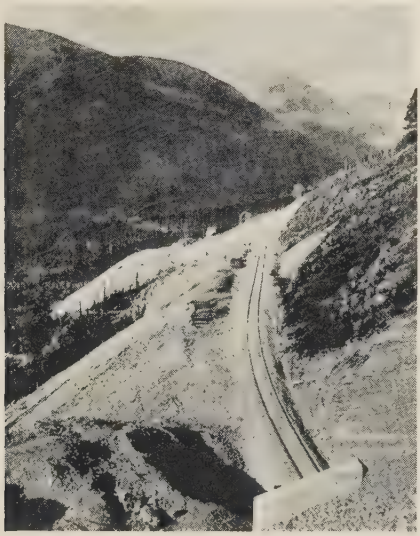


FIG. 136. MOUNTAIN WALLS

The Rockies as a barrier to transport. Spiral tunnels on the C.P.R.

enclosed lowlands may now be broadly treated. To the north is the wide depression between the two main fold-lines down which the Yukon makes its way to the Bering Sea. Around the lower course of the Yukon, and along almost the whole Alaskan coast-line fronting Asia, is a low-lying coastal plain which resembles the northern prairies on the Arctic coast. From the Aleutian corner right down to Puget Sound, the entire coast of Alaska and British Columbia is a long sunkland where the deep alpine valleys have been drowned,

forming fiords on an even grander scale than those of the South Island of New Zealand or of Norway. The Californian coast, on the other hand, is mainly a raised region; indeed, in certain areas, the upward movement is still in progress. The coast-line here is vastly different in character and outline from that farther to the north.

The chief rivers of the west have gouged deep canyons in the plateau. For the longer part of their courses, owing to the general trend of the ranges, these rivers have a northerly or a southerly direction which usually changes abruptly where they break through the western wall in a series of mighty gorges. On the Pacific edge of North America, to a greater degree, perhaps, than anywhere else in the world, the political boundaries run counter to the natural frontiers. In every case between Canada and Alaska, between Canada and the United States, or between U.S. and Mexico, they must be entirely disregarded in treating the geographical regions.

The presence of this great plateau means more than can be understood to the life of North Americans. In the first place these high elevations have for long ages acted as traps for the moisture coming from the Pacific. Mostly it piles up above the snow-line to melt in the dry summer when the dry lands of California most need the water for irrigation, or to form huge glaciers which feed continuously the Pacific rivers farther north. Secondly, the constant rainfall along the seaward slopes north of 40° has made possible the rich forests upon which so large a section of the peoples of the Pacific Basin are dependent in so many ways. Again, the force of these streams in their rapid descent to the sea is a power that man is gradually harnessing for his use by changing the force of falling water to electricity. Engineers calculate that in the northern section of the plateau not less than twenty million horse-power is running to waste. The state of Washington has 9,000,000 horse-power available, of which only 500,000 is being used; Oregon has 7,000,000 and is using 300,000;

British Columbia commands 2,000,000, of which about 500,000 has been applied. The possibilities for the industries of the future are tremendous, especially in the application of this power to saw-mills, pulping-plants, and the extraction of ores. This brings us to the fourth great endowment of the region, the rich store of mineral wealth in the rocks of the plateau which is at present almost untouched.

In sober fact very few regions of the earth's surface are so favoured in respect to climate, production, power, or scenery. From the richly productive fisheries of the northern fiords to the wide Mediterranean fruit lands of California, and from the gold of the mountains to the golden grain of the valleys, there is a range of products of which few lands can boast. The saddening feature will be impressed at every turn that man has not used this precious endowment wisely. He has been engaged in 'skimming the cream of a continent', as that eminent geographer, Russell Smith, has put it, for his own large profit, to the complete disregard of the people of the future and the rights of the matter. A few people are here prodigally using up the stored wealth of centuries and wasting by fire and carelessness enough to supply millions on the other side of the Pacific.

Chapter XXVII

ALASKA AND THE NORTH COAST

This great sub-arctic region is still so unexplored and undeveloped that we know comparatively little about its resources or its capacity for supporting human life. It may be treated broadly as falling into four divisions: (i) the Arctic lowlands; (ii) the Yukon Valley; (iii) the mountain areas; and (iv) the Pacific Coast.

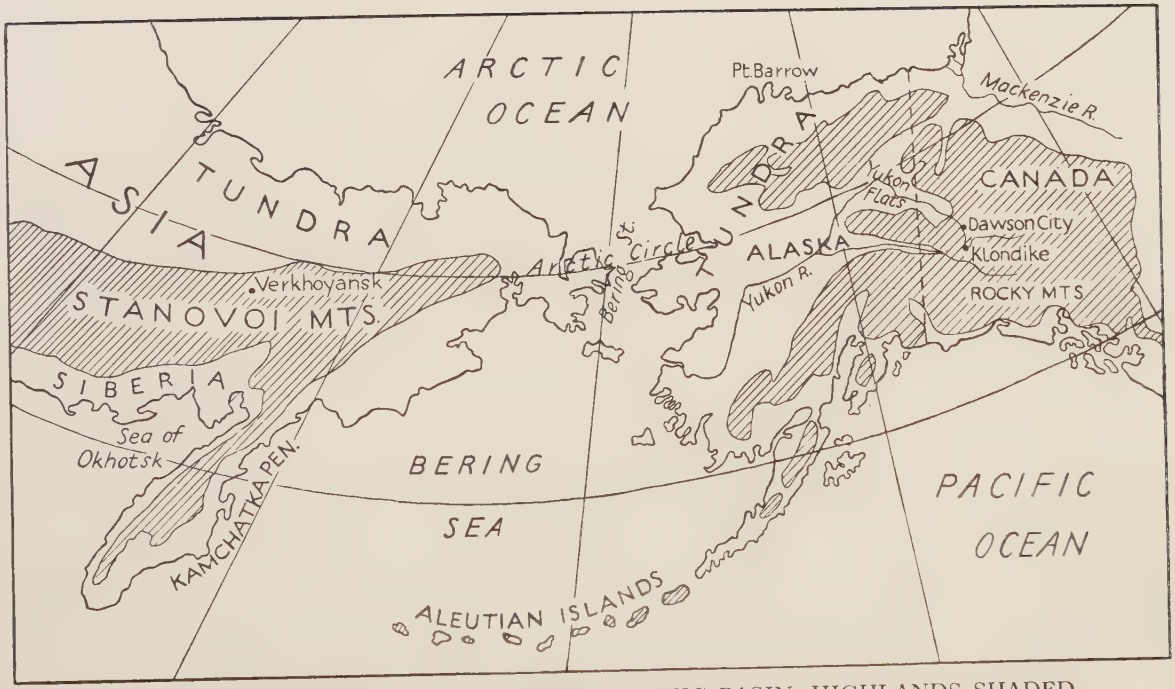


FIG. 137. THE NORTHERN RIM OF THE PACIFIC BASIN, HIGHLANDS SHADED

1. *The Arctic Lowlands*

These are really a small part of that vast tundra region stretching across the whole of northern Asia and North America, and what has been said of the Asiatic side also applies fully to the lowlands of Alaska. Slightly more favourable climatic conditions, however, here support a considerable amount of animal life of various types, but especially the deer family; and the caribou, the musk-ox, and many fur-bearing animals have attracted trappers and hunters since the land was discovered. The nomadic Eskimo tribes living in the region have proved in a wonderful fashion that it is possible for man to live, and to live comparatively well, in these Arctic lands; and explorers such as Stefansson have taken up the defence of what is commonly considered to be an extraordinarily desolate country. The government of the United States, of which Alaska is a dependent territory, has given a considerable amount of attention in recent years to the possibilities of pasturing reindeer, and of developing a system of agriculture suited to the short, hot summers and cold winters. The chief settlements consist of fur-trading stations of which the chief is *Nome*, and of Eskimo communities along the coast.

2. *The Yukon Valley*

The lower part of this valley is a broad flood plain 5,000 square miles in extent, but its grave climatic misfortune is that it opens on the cold Arctic seas, rather than on the warmer northern Pacific, from which it is shut off by the high wall of the Alaska Mountains. The valley itself is mainly forest-covered, but the trees become thinner and disappear towards the tundra areas and the higher slopes. The rainfall, or rather snowfall, is comparatively light; and great climatic extremes are experienced. The lowest recorded temperature reached 54° below zero, and the highest 100° above. The valley has been called the 'Finland of America', and attempts are being

made to establish cultivation based upon hardy crops such as barley and potatoes. Despite careful scientific experiments the land remains largely unpopulated, and is likely to be so for many generations to come.

FIG. 138. GOLD MINING IN THE YUKON VALLEY

The difficulties presented by sinking shafts in the frozen ground are indicated by the pile of wood in the foreground. The earth is thawed by means of fires or, on the bigger 'shows', by jets of steam

3. *The Mountain Areas*

These are extremely rugged regions of almost everlasting snows and great glaciers. Transport under ordinary climatic conditions would be very difficult, but even railways would be of little use in this vast upland. Much mineral wealth is undoubtedly lying here untouched, and the gold production of the palmy days of Klondike and other fields may yet be repeated.

4. *The Pacific Coast*

For convenience, the coast is taken to extend as far south as Vancouver Island, although there are considerable climatic and other differences between the northern and southern sections. This area is really a great sunk-land which runs

FIG. 139. DAWSON

On the Yukon in Canadian territory, the modern descendant of the great Klondike gold rush. The Yukon is the main artery of this region

from Bering Sea to Puget Sound. The heavier rainfall of past ages eroded deep valleys in the young Alpine mountains which hug this coast; and, when the subsidence took place, these valleys were drowned, forming the fretwork of innumerable fiords that now constitutes the shore-line. Some of these fiords are more than 2,500 feet deep and run between their rock walls for 200 miles into the heart of the Coast Range.

Extending from the north-west corner of the continent

is the 500 miles of the rocky Alaska Peninsula from which, as from a peg, hangs the festoon of the Aleutian Islands. The islands are volcanic, and contain some of the largest active craters in the Pacific region. Off their shores the cold Arctic currents meet with the warmer Pacific circulation, and this gives rise to fogs for almost the whole year round.

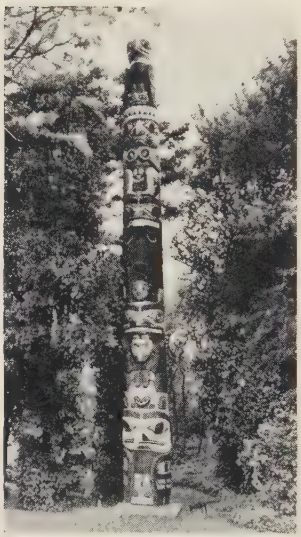


FIG. 140. AN ALASKAN FAMILY TREE

A totem pole now erected in a public park in Victoria, Vancouver Island. The soft pine wood of the coast, of course, made such carving possible

Piled up on the lofty ranges behind the coast are the great glaciers that fill the upper valleys, and, in some cases towards the north, reach right down to the sea. The fronts of these glaciers are constantly breaking up into lumps that float off as icebergs to the serious danger of navigation in this part of the world. The whole seaward slope is comparatively steep; but, exposed as it is to the wet winds from the Pacific, it is covered with a forest composed mainly of pine in the south and of spruce at the northern end.

The natives of this area are a people intermediate between the Eskimoes and the American Indian of the Great Plains. All three are Mongolian in origin, and probably came to North America by way of the Aleutian bridge before the great subsidence. In many ways, such as hardiness, adaptability to a cold environment, methods of community life, and character of houses, weaving, and carving, the Indians of this coast resemble very strongly the Maoris of New Zealand.

The occupations of the coast regions are mainly three, fishing, forestry, and mining. Of these fishing is easily the most important. The fisheries depend upon the world's needs for food and fur, and so the salmon and the seal are as important here as wheat crops are to the people of the prairies.

FIG. 141. THE SALMON SPY

The 'run' of salmon in a British Columbian river spotted from an aeroplane

The salmon, in particular, has become the basis of a great industry. The salmon is a deep-sea fish which returns in vast numbers to breed in the glacial rivers where it was born. As the shoals swarm up the western rivers during the summer they are netted and trapped in countless thousands, and canned for export to almost every country in the world. So great has been the havoc wrought by the fisheries that there is danger of extermination of these fish, and the 'run' and 'catch' vary

very much from year to year. The fur seals, on the other hand, are found year after year in large numbers on the islands along the coast. Here again the unscientific method of killing threatened the industry with extinction, but an agreement between the governments of Russia, Japan, and Canada

FIG. 142. SALMON CANNERY

On the Skeena River, British Columbia. The cannery opens for business each year just before the salmon are expected to run

has made regulations for the sealing industry that have apparently checked the mischief.

Mining, as an occupation in this area, is not very prosperous, probably owing to the easier conditions of the other great mining fields of the Rockies. West of Mount St. Elias it is known that rich deposits of copper, gold, and coal exist; but so far they are scarcely touched.

The chief settlements along the coast are *Skagway* and *Juneau* in Alaskan territory, and *Prince Rupert*, the terminus of a trans-continental line near the mouth of the Skeena River

and the most northerly town in British Columbia. Prince Rupert expects some day to be a grain port for the northern wheat lands of Canada. *Stewart* is the centre of a mining district of growing importance.

Chapter XXVIII

THE PUGET SOUND–WILLAMETTE VALLEY

1. *Relief and Climate*

Lying between the Cascade Mountains and the maritime ridge is the most northerly section of the long coastal depression. In length about 450 miles, this depression commences in the south as the Willamette Valley, takes in the middle part of the Columbia Basin, and disappears under water to the north as Puget Sound. The lower valley of the Fraser also belongs to this depression. The comparatively low maritime ridge, here known as the Coast Range, shelters the valley from the excessive rainfall of the coastal strip, whilst the high wall of the Cascades conserves the rainfall in the form of snow, and feeds the rivers through the dry summer.

Generally speaking, the climate of this region is very similar to that of western Europe from Britain to the Baltic, and the typical mild winters and cool summers of all west-wind climates are the rule. According to whether the lowlands are sheltered from or exposed to this westerly circulation climatic conditions vary very widely. The official meteorologist of British Columbia says of his province: 'In some districts between the mountain ranges the rainfall is so light that irrigation is necessary, and maximum summer temperatures range from 90° to 100°; while on the west coast of Vancouver Island at Henderson Lake, which is situated immediately

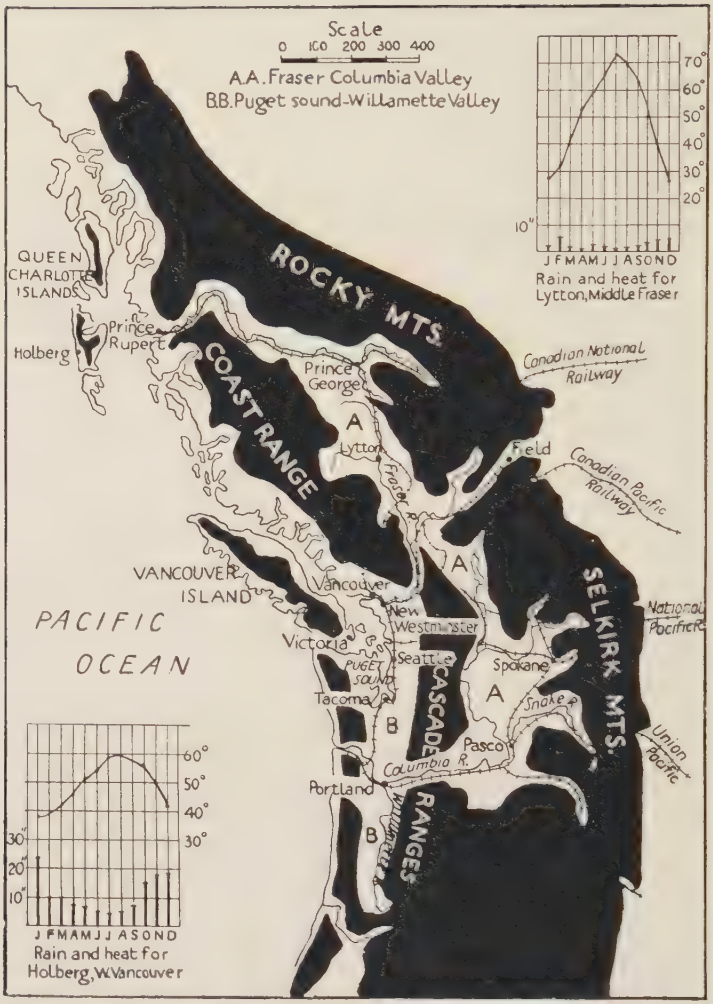


FIG. 143. PUGET SOUND, FRASER AND WILLAMETTE VALLEYS

westward of a mountain, the precipitation in 1926 was 284 inches, which may make it the wettest place in North America.' Consider these weather records and note the position on the map of the places concerned.

	Temperature.		*Rainfall.*
Place.	*Max.*	*Min.*	*Inches.*
Henderson Lake (West Vancouver)	80	22	284
Nanoose Bay (East Vancouver)	87	14	30
Prince Rupert (North Coast)	82	18	95
Quesnel (Upper Fraser)	96	−17	13
New Westminster (Lower Fraser)	91	15	50

Most countries having a climate of this type are heavily forested; they comprise, in fact, the great temperate softwood forest regions of the world. For 1,500 miles, on this coast, hundreds of river valleys and thousands of hill slopes have been the nursery of the most wonderful softwood forests that the world knows. From the Douglas fir of the south to the Sitka spruce of the north there is a priceless treasury of timber here that has taken centuries to grow. Settlement involves the removal of this forest, or at least parts of it. The problem is the same for British Columbia as for Tasmania, the same grave disadvantages are apparent, since settlement means usually the reckless despoiling of regions that are natural forests, and in most cases can be nothing else. Even when the forest is cleared at great expense in effort and money the bracken fern often takes charge, and man abandons the struggle with Nature. Another tendency after deforestation is for the soil to be washed away from the slopes, especially in the more hilly country. The problems

of settlement increase in the wetter regions to the north. The whole valley region, however, is a good mixed farming area, and the climate is very suitable for dairying. The crops, too, are the usual temperate climate grains from the hardy barley and oats to the north, to the wheat of the southern valleys; and this is combined with much stock-raising.

FIG. 144. SAW-MILL AND BOX-FACTORY, OREGON

Into the voracious maw of these mills the Douglas fir forests of the Pacific slope are fast disappearing

After timber, it is as orchard country that the area makes its chief claim. The absence of frosts at budding time owing to the diffusion of mild oceanic conditions far inland, and the shelter from heavy winds in valley situations, provide the ideal situation for apples, pears, plums, and cherries. In addition the small fruits of the berry family are all well suited here, and the cultivation is extensive. So it is a very natural development that all the valleys opening on the Puget Sound, just as the eastern and northern valleys of Tasmania and of the North Island of New Zealand, have become great fruit-

producing areas. Similarly, the chief factory industries are jam-making, fruit preserving, canning, and pulping, and the preparation of fruit juices.

The greatest industries of this region, however, are connected with the forest. In these days saw-milling has to be compared with steel-making because the raw material is so

FIG. 145. STAND OF YOUNG DOUGLAS FIR
Vancouver Island

massive and such huge mechanical appliances are needed to deal with it. So we find that the modern development is to place the great mills on the water front, where the logs can be floated down and where the deep-sea ship can come for the timber. Running back into the forest from lake, river, or the mill itself are the tramways down which the giant logs come in sections—a tree to a train—to be torn and sawn and shaped for the timber markets of the world; or pulped to make the newspapers of six continents. The newest industry

to commence another onslaught on the forests of the world is that of rayon or 'artificial silk' manufacture. This depends upon cellulose and the raw material is again wood-pulp. The chief consolation is that there will be less waste, since what the timber man does not use may become pulp for either paper or rayon. But even the mighty forests of the Pacific

Fig. 146. VANCOUVER

coast cannot meet these demands for many years at the present rate; and the day must come soon when the world will have to ration its softwood supplies.

From the industrial point of view the chief advantage of the region is the unlimited power available in the streams of every valley along this coast. Oregon, Washington, and British Columbia are all turning this force to account in developing electric power for mills, and great extensions are constantly being planned. So far its use is confined mainly to the industries connected with timber and paper, and to driving machinery in local works such as jam factories, can-

ning works, flour-mills, and engineering shops. Because of her great water-power British Columbia may yet become the chief manufacturing area of the North Pacific as New Zealand may for the South.

The main gateways of this region have acquired a double importance as collecting and distributing centres for the

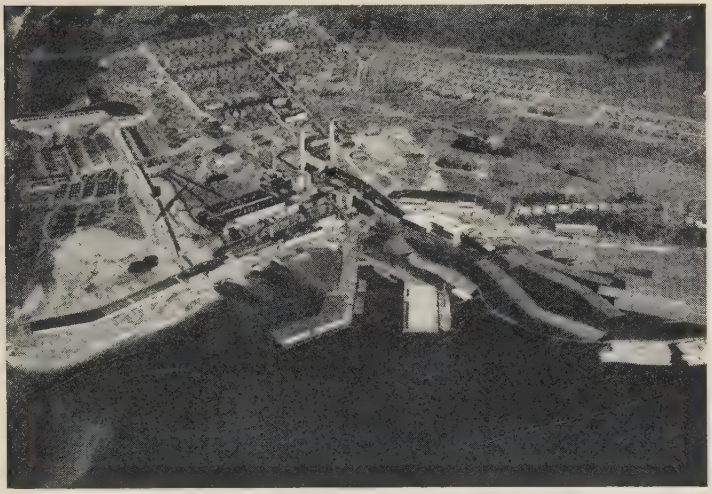


FIG. 147. POWER PLANT AND PULP-MILL

On the Powell River. Note the pipe lines leading to the power-house, the rafts of logs, and the 'Company' Town

trade connected with the interior, and as manufacturing centres, since the great development of the age in connexion with big ports is the tendency for manufactures to migrate to the sea-board. *Vancouver* (350,000) is situated on Burrard Inlet, a wonderful land-locked harbour near the mouth of the Fraser. It is the largest port on the Pacific coast of North America, and being ice-free for the whole year is the chief port of Canada for certain months. As a growing industrial centre it derives its power from several sources, but chiefly

from Stave River and Lake Buntzen, 42 and 16 miles away respectively. Another big plan to derive power from Bridge River is just completing, and these schemes will give the area 700,000 horse-power for industrial purposes. As the terminus of the most important Canadian trans-continental lines, Vancouver has become the chief Pacific grain port for the prairies.

FIG. 148. THE HARBOUR OF VICTORIA, VANCOUVER ISLAND
From an aeroplane

New Westminster (18,000) is an important saw-milling and wood-pulping centre on the lower Fraser, and a grain port.

Victoria (72,000) on a harbour at the southern end of Vancouver Island, is the capital and administrative centre of British Columbia. It depends mainly on industries connected with timber, and on the agriculture and dairying of the eastern side of the island.

Seattle (320,000), the capital and main port of the state of Washington, is situated on the wonderful waterway of Puget Sound, 150 miles from the open sea. It is the terminus of two

trans-continental lines and is rapidly becoming the chief Pacific port of the United States for certain trades. An important ship canal has been constructed between the harbour and Lake Washington.

Portland (260,000), the capital of Oregon state, is a port of different type. Situated 100 miles up the Columbia river it is the chief gateway for the lower end of the valley, and is Seattle's chief rival in the north-west of the United States. The harbour works at the entrance to the river were extremely costly, but miles of river front are now available for shipping. It is the chief Pacific terminal for two trans-continental railways.

Tacoma (100,000) is another important outlet at the head of Puget Sound.

Chapter XXIX

THE FRASER–COLUMBIA VALLEY

1. *Relief and Climate*

A second valley region lies between the Coast and Cascade ranges on the west and the Rockies proper (Selkirks) on the east. It embraces the upper and middle valleys of the Fraser and Columbia rivers. Most of the area is a plateau region dissected by the deep gorges of the two rivers and their tributaries. The Fraser Valley lies wholly within Canada, and its area of cultivable land is considerably less than that of the Columbia Basin.

The whole area presents one of the surprises of the Pacific coast, and this is due to the arrangement of mountain and valley in relation to the wind-circulation, a situation which has already been discussed. The rain-bearing winds must cross the maritime ridge in Vancouver Island and the higher

Coast and Cascade ranges before they reach the valleys, and consequently the valleys, especially on their western side, tend to dryness. Look at these rainfall figures for Henderson Lake on the west side of Vancouver Island, and Lytton in the middle Fraser Valley:

Monthly Rainfall in Inches, 1926 (approx.)

	Total.	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.
Henderson Lake	313·6	23	40	14	13	21	4	14	5	7	49	38	56
Lytton	12·25	0·7	2·8	0·4	0·2	1·6	0·9	0·1	0·7	0·5	1·5	1·4	1·7

It will be seen that there are almost desert conditions in parts of the valley; and, in general, the eastern sides are better watered than the west slopes in the lee of the ranges. Kamloops sometimes gets less than 5 inches during the year. The rain falls chiefly during the colder months, and is associated with the cyclonic storms which sweep in from the Pacific during this season.

The distribution of the rainfall over the region determines a definite arrangement of orchard, farm, and pastoral country. The dryness is not entirely a drawback, however, as the fertility is not washed out of the soils, and where irrigation is possible, the land is very productive. The rolling hills of much of the Columbian Basin are in great contrast to the rocky Alpine areas of the Fraser, and this is chiefly a result of glacial action in past ages in both cases. The ancient glaciers scoured out the Fraser very cleanly, but in the Columbia Basin much glacial rubbish was left behind to form good hill-farm country. The Walla Walla Plateau on the east of the Columbia region has great stretches of unproductive upland. The middle part of the basin is sufficiently far south to experience a fairly long hot summer; and, in addition, the lava flows of past eruptive periods have here weathered into comparatively rich soils. Thus soil and climate are both

adapted for growing wheat, and the Columbian wheat lands yield an average of about 20 bushels to the acre compared with the 15–16 bushels of the prairies. The largest area of wheat country lies round *Spokane* (104,000), a railway centre which has become the trading and distributing headquarters for

FIG. 149. TYPICAL CANYON IN THE ROCKIES

Mining and lumbering are the chief occupations possible in these Alpine areas

the whole upper Columbia Valley. The agriculture, stock-raising, and timber-cutting industries are its main support.

Washington state has become in recent years a great apple-growing area. That part of the Columbia Basin at the foot of the Cascade ranges has been developed into the orchard areas of the Okanogan, Wenatchee, and Yokima Valleys. The neighbouring Hood River Valley is a similar orcharding district. Most of the remainder of the Columbia Basin is natural grassland. In both the Fraser and Columbia areas the ranges are devoted to cattle- and sheep-raising. The chief difficulty in the way of agricultural development in the

Fraser is the comparatively small area of level land, and in this respect it much resembles Norway. The depth at which the Columbia flows across most of the upper basin is the chief drawback there. Water for irrigating the fertile uplands is there, but the expense of raising it is the chief problem.

Kamloops (6,000) is the chief settlement in the upper Fraser Valley. The chief crop of the lower part of the valley is apples, grown chiefly around Lake Okanagan, a glacial lake, some 40 miles in length.

FIG. 150. FRUIT-GROWING IN THE OKANAGAN VALLEY
Note the treeless ranges in the background

Chapter XXX

CALIFORNIA

1. *Physical and Climatic*

The dominant influence of the plateau region is maintained throughout the 750 miles of California. The main range, really a high plateau 75 miles wide, is here known as the Sierra Nevada. Its highest ridge is generally about 10,000 feet above sea-level, but Mount Whitney towards the south rises to nearly 15,000 feet, and is the highest peak in the United States. In contrast to the Selkirks, the slope towards the ocean is gradual; and this is a fortunate circumstance for California in many ways, but particularly because it enables the maximum amount of moisture to be extracted from the Pacific winds. About 50–60 miles nearer the coast and much lower than the Sierras is the maritime ridge here known as the Coast Ranges. Between the two highland areas is the long narrow valley of California, a great depression once part of the Pacific but now filled with the sediments washed down from the enclosing mountains.

The position of this valley with relation to the wind systems is of importance. It lies along the front of the North Pacific high-pressure area; and for the greater part of the year the circulation tends to be towards California. After September, when the wind system has swung south with the sun, the area comes into the zone of prevailing Westerlies and lies on the margin of the cyclonic belt. Most of the rain, therefore, falls between October and May, the remaining months being a season of summer drought much like that experienced in the Mediterranean region, or in southern Australia. The highest rainfall, in places as much as 200 inches, is trapped on the Sierras, where it lies in the form of snow, another fortunate circumstance for the valley since the run-off from the melting snows fills the streams for the warmer season of maximum growth. But this run-off varies in a remarkable manner, and

provision has had to be made for storing and regulating the water flow in a large portion of the region. The valley itself is a dry area, tapering from 25 inches of rainfall in the

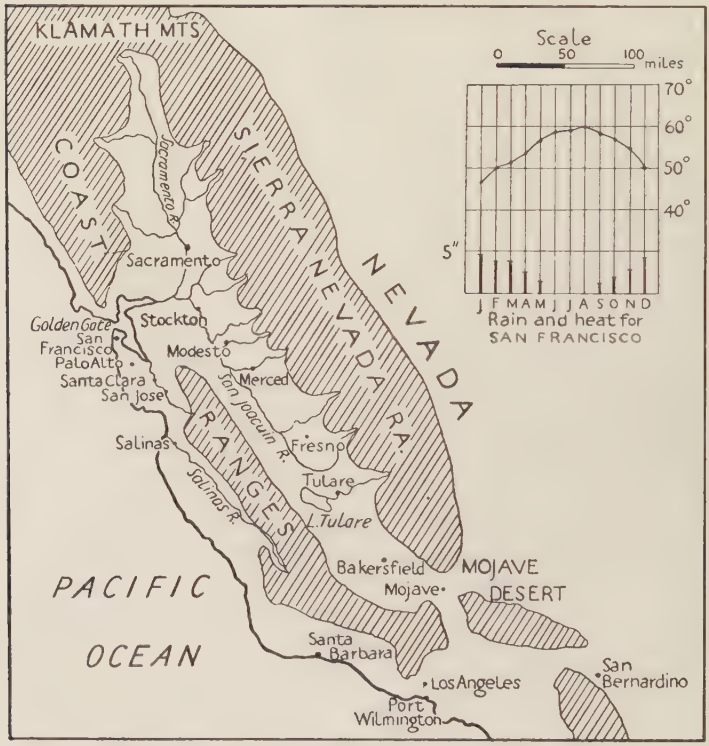


Fig. 151. CALIFORNIA, Highlands shaded

north to 5 inches and less in the near-desert to the south. As a consequence irrigation means as much to California as it does to Egypt. One other advantage from the presence of the plateau lies in the possibility of utilizing the water-power available in the ranges.

The Sierras protect the Great Valley from the cold inland

winds of winter and the scorching winds of summer, and the valley is thus sheltered in a way that determines its chief use as a fruit-growing area. Rising from the valley floor, four zones of vegetation may be distinguished: (i) the grasslands of the foot-hills up to about 1,500 feet, where rainfall is hardly sufficient for trees; (ii) the zone of drought-resistant vegeta-

FIG. 152. CALIFORNIAN LANDSCAPE

Looking towards Santa Clara Valley. Notice the typical evergreen 'live oaks'

tion, up to approximately 3,000 feet, especially characterized by the yellow pine; (iii) the zone of heavy rainfall and big forest trees, especially the sequoias (se-kwoy-a), which shades off towards (iv) the summit areas where cold becomes too great for plant growth except of a stunted kind in sheltered situations. It is evident from this brief survey that the Sierras spell water, power, and timber for the inhabitants of the valley; and it would be no exaggeration to say that but for the Sierras California would be largely desert.

2. *Economic*

California is in many ways very similar to great tracts of southern Australia, and especially resembles the Murray River Basin. The San Joaquin (San Hwak-een) Valley might compare with the Murray Valley in a more fully developed

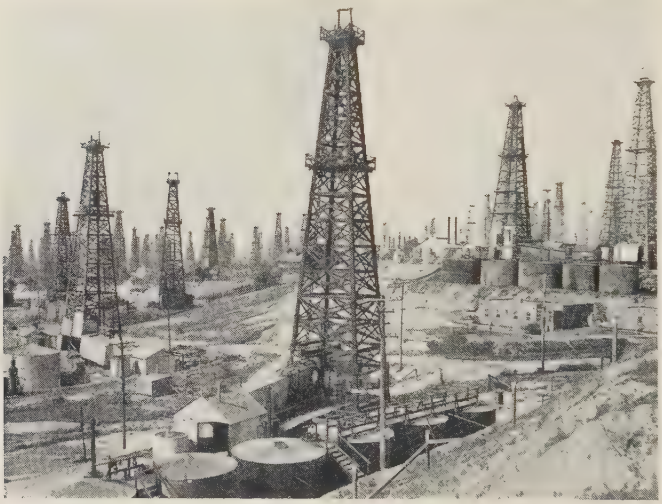


FIG. 153. OIL-FIELD IN THE LOS ANGELES DISTRICT

stage. Further, California and Australia have gone through similar stages of settlement. In both there were the first stages of pastoral estates with population spread very thinly in the valleys, the frontier stage as it has been called. Then after 1849 came, for each, the period of the gold discoveries which did so much to stimulate interest in the new lands and to provide capital for its development in other ways. In both countries mining is now a declining industry, and they have turned largely to wheat-growing and fruit-growing as the main rural industries. But here comes a great difference in

the history of the two regions. The discovery of mineral oil in California has had no parallel in Australia. This has led to the development of great industries in the Californian Valley, and has given it an added importance in the commerce and trade of the Pacific. We may notice other likenesses between the Australian and Californian areas, the dependence upon

FIG. 154. ORANGE GROVES
San Joaquin valley with sierras in the background

irrigation and upon artesian water, the character of the vegetation—a likeness that has been intensified since the wholesale introduction of the eucalypts and other Australian trees—and the outdoor life of the people, which is, of course, a climatic effect. A further result of the similarity is the fact that California and Australia are very often competing in the same markets as sellers of similar products.

Southern California does not properly belong to the Great Valley; but is a region lying between the plateau and the sea, and having in general a somewhat hotter, drier climate than

that of the Great Valley. A marked feature of the southern area has been the adoption of Spanish and Italian models in architecture. These types of building are particularly suited to the country, and J. R. Smith has called the development 'a nice recognition of geographic influence'.

Fig. 155. SAN FRANCISCO

California is, for the most part, the Great Valley. Leaving Los Angeles the main northern railway runs through barren canyons on the edge of the Mojave (Mo-hā-vay) Desert and zigzags to the top of Tehachapi Pass. From here the line drops sharply for 3,000 feet to the floor of the Great Valley, and runs in an almost straight line towards Stockton. Running back into the heart of the Sierras are the valleys carved out by the rivers which join the San Joaquin, the main stream of the Great Valley. These spur valleys and the floor of the main valley are the areas irrigated by the run-off from the Sierras. Every 50 or 60 miles along the line the canning and packing sheds of a large town tell the story of the valley, even if 300 miles of irrigated orchards and vineyards have not already

done so. *Fresno* (70,000) is the centre of the grape country and the head-quarters of the important raisin industry. *Merced* and *Modesto* are the centres for fruit drying and canning. Every now and then along the line a great fruit express with a train of cars a mile in length passes on its way

FIG. 156. VEGETABLES BY IRRIGATION
Celery growing in Sacramento Valley

to San Francisco or Los Angeles. From *Stockton*, northwards, similar cultivation, varied to a greater extent with wheat, continues up the Sacramento valley; and the two valleys comprise one huge orchard region supplying fruit and fruit products to all parts of the world. On the seaward side of the coastal ranges lie the Santa Clara and Salinas valleys where fruit production has specialized along certain lines. *Santa Barbara*, for example, is the centre for most of the prune-growing of California. Careful measures have to be taken to

protect the fruit areas from late frosts despite the generally mild climate. The lowest parts of the Great Valley, like the similar regions of the Murray, have been reclaimed by levees, partly natural, and on these areas dairying is established. Rice is also cultivated very successfully under irrigation. One great difficulty is common to both the irrigation areas of

FIG. 157. PORT WILMINGTON

The harbour that Los Angeles 'scooped from a ditch'. Oil-fields and giant storage tanks in the background

Australia and California, viz., that of 'salting'. The irrigation brings up salt from some depth in solution, and this collects on the surface of the ground when the water has evaporated. After a time the soil becomes too salt for plant life. This problem is being solved by deep drainage.

San Francisco (1,000,000) is the main gateway of the Great Valley. Situated on a magnificent landlocked harbour, it is the largest port of the Pacific Coast, with great industries dependent upon the production of the back country, and

with much 'through' trade to the eastern states from all countries of the Pacific. The important universities of *Berkeley* and *Palo Alto* (Stanford) are in the neighbourhood.

Los Angeles (1,260,000), the southern capital and university town, is also rapidly developing as an industrial and residential centre. It is the centre of the American film industry. Its port is at the artificial harbour of Port Wilmington. Water is brought 250 miles from the Sierras.

Sacramento (100,000) is the metropolis of the fruit and wheat region in the northern valley.

Chapter XXXI

THE DRY LANDS

Between the Sierras and the wide sweep of the Rockies towards the east stretches a great arid plateau region stepping down from (i) the High Lands of Wyoming and Colorado to (ii) the lower levels of New Mexico, and rising again to (iii) the Mexican tableland. These are the three main divisions that approach nearest to the trade-wind deserts of other continents, and are most arid in the Mojave Desert and the Bad Lands of Arizona.

1. *The Utah Plateau*

Lying in the rain shadow of the mountains, this plateau, because of its general elevation, receives sufficient rainfall to maintain grasses and sage brush, and the area is thus a great natural pasture with scattered patches of forest. It comprises a region of inland drainage concentrated in the Great Salt Lake, the only outflowing stream of any size being the Snake River at the north-western corner. Sheep- and cattle-raising, with cultivation in the irrigated oases, and silver-mining in the ranges, comprise the main occupations of the region. The

lakes are the shrunken relic of one ancient lake, and are remarkable for their salinity. Many of them are often merely salt-encrusted mud-flats like those of Central Australia.

FIG. 158. COLORADO AND MEXICO
Highlands shaded

The climate is much more continental in character; and, despite the high day temperatures, frosts are experienced right through the year in parts of the plateau.

The rich soils of the basins make for great fertility where irrigation can be practised; and *Salt Lake City* (120,000) is

a great metropolis entirely dependent upon irrigation. Big storage basins support other agricultural and pastoral centres such as *Ogden* and *Carson City*. The Snake River area is an old lava plateau that has been dissected by the streams which have carved out deep canyons. Here there is rich soil and water, but the water is at such a depth below the level of the plateau that little cultivation is possible.

FIG. 159. THE DRY LANDS

The cowboy at home in the treeless range country

2. *The Great American Desert*

The driest parts of these areas are also the lowlands such as the Mojave Desert, Colorado Desert, Bad Lands of Arizona, Sonoran Desert, and Lower California. The rain falls mostly along the enclosing mountain rims. There is a remarkable range of comparatively useless vegetation over the whole desert, and the plants of the cactus family are very prominent. Rain-storms are responsible for the remarkable erosion that is so pronounced over most of the area. But 'this region is by

no means devoid of natural resources or human activity', says a Government bulletin. 'It contains prosperous cities, fertile agricultural districts, forest-clad mountains, a large aggregate number of watering-places, some rich mines and an unknown wealth of mineral deposits. But the localities that have water-supplies are widely separated oases in a vast expanse of silent, changeless, unproductive desert, whose most impressive feature is its great distances, and whose chief evidences of human occupation are the long roads that lead from one watering-place to another.' The irrigation areas that exist depend on giant storages such as the Roosevelt Dam. A remarkable feature of the whole region is presented by the tremendously deep and long canyons which have been gouged out by the main streams, and these lend themselves to the purposes of the engineer in the storage of water.

FIG. 160. A GIANT OF THE DESERT

The strange grotesque vegetation of the desert forms one of the wonders of the Dry Lands. Compare the two inhabitants, the mounted cowboy and the giant cactus

The Colorado is the Nile of the American Desert through which it flows for 1,500 miles, draining 200,000 square miles of basin. Its erosive power is so great that it is gradually filling the head of the Gulf of California. The old head of the inlet is represented by Salton Sea, and the alluvial area between this and the sea has been reclaimed and irrigated, and is now the wonderfully productive Imperial Valley. *Yuma* is the centre of the area. Other similar projects are in process of completion.

3. *The Mexican Plateau and adjacent Coast*

This is a great tableland of dry watercourses and sage-brush vegetation. The high evaporation of the region makes even ten inches of rainfall useless, and for the most part the plateau is a seasonal pasture similar to the interior of

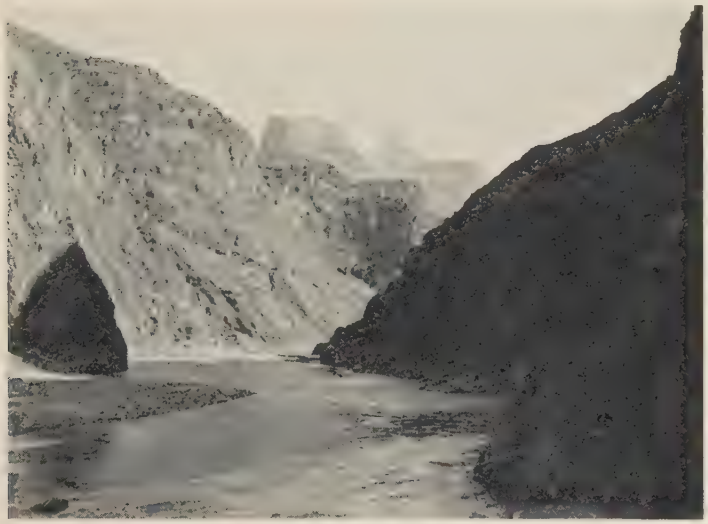


FIG. 161. IN THE CANYON OF THE SNAKE RIVER, IDAHO

Behind the Pacific Mountain system and north of the Great Desert lies the arid western plateau into which the rivers have carved the grand gorges known as canyons

Australia. But even here some irrigation is possible, and on the Atlantic side the great reservoir at Elephant Butte shows that the best is being made of the possibilities. But there is much wealth of minerals, particularly silver, gold, copper, and bismuth.

In a region full of magnificent gorges the Grand Canyon stands out as the best example. The tableland is here 5,500 feet above sea-level, and the floor of the canyon is 2,500 feet

below the level of the plateau. The past history of the region is of great interest. The Spanish colonists found in New Mexico the remains of a wonderful early civilization; and the cliff dwellings and other evidences show that an advanced stage of culture had been reached. They found also the

FIG. 162. ELEPHANT BUTTE DAM

Man's mighty response to a desert environment. The power plant on the spillway shows the size of the wall. Its only rival in point of water retained is the Hume Reservoir on the Murray River

Indians of the area living in villages with well-constructed houses, and far advanced in the arts of weaving and pottery. The Spaniard took the Indian and converted him to a feudal slave, the *peon* of the great ranches of the early days.

'The peons', says J. Russell Smith, 'are in reality mediaeval vassals, little better indeed than chattels, strangely like cattle. Corncakes, fried beans and onions are their chief food. Their one ornament is the highly decorated and appallingly heavy hat; their

one entertainment is the church procession, their one luxury to get drunk on fierce liquor. Such is the life of the poor peons, millions of them. They cannot get ahead financially. They are quite unambitious. They are also exceedingly conservative. They cut their grain with a sickle, and shell their maize by hand, and

FIG. 163. A *PUEBLO*, OR INDIAN TOWN

A typical relic of the Navajo and Hopi Indians in the dry lands of Colorado

only with the greatest difficulty can they be induced to use more efficient tools.'

Such is the legacy of Spanish occupation, and we shall see the same thing from Mexico to Chile. Backward, primitive peoples; so devoid of implements that the sheep in certain districts are shorn with broken glass.

The lower Colorado is a true tableland, the *mesa* as it is called. Here again is a very interesting native people, the Hopi Indians, wonderful farmers living in walled villages.

They tend large flocks of sheep and goats on the ranges, and carry out a most laborious cultivation in the oases where water is available.

Chapter XXXII

THE PACIFIC COAST OF CENTRAL AMERICA

The high backbone of mountain through Central America runs very close to the sea on its western side. As a consequence the Mexican and Central American tablelands are completely cut off from the Pacific by a continuous mountain wall; and there is scarcely a break of any kind along the whole coast-line from Lower California to Panama. In addition these lands are in the area affected by the trade-wind system which brings moisture from the Atlantic, so that the west coast is in the lee of the Sierras; and becomes in effect an extension to the southward of the dry region of Arizona and Colorado. Physically and economically Mexico and the Central American countries turn, therefore, towards the Atlantic; and the Pacific coast contains very few people and no industries of any importance.

The coast south of Mexico is, if possible, even more monotonous and arid than it is to the north. Along the beach runs a strip where the coco-nut palm grows naturally in its wild state. Farther back is a strip of grassland which supports a few cattle. In favoured situations above 3,000 feet appear the scattered patches of forest, mainly in the short deep upper valleys. Some of the lower valleys have been irrigated, and sugar-cane and other tropical crops form the basis of a scattered agriculture. A few small ports carry on an intermittent trade in copra and hides and even a little mineral ore from the highlands; but good harbours are lacking. The best

port on the Mexican coast is *Acapulco* (5,000). The Pacific coast of Honduras has the best harbour for the whole in the small Gulf of Fonseca, on which stands the port of *Amalpa*, mainly important because it is leased by the United States as a naval station.

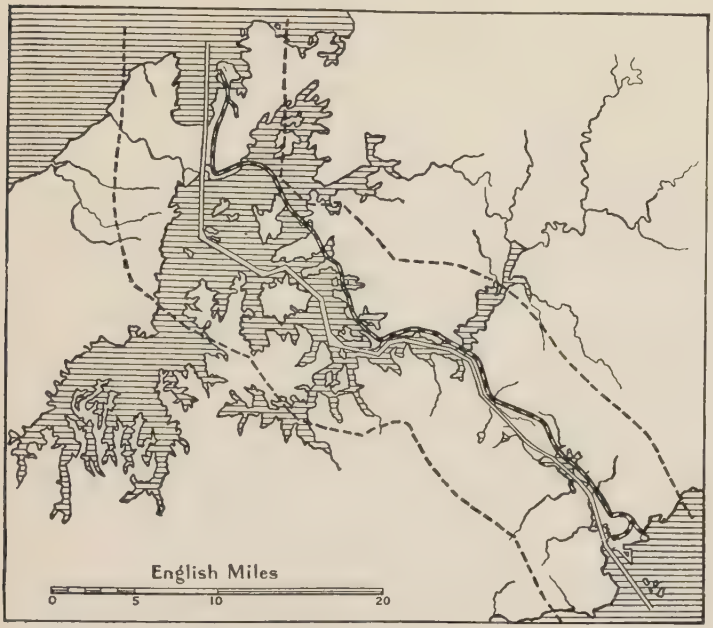


FIG. 164. THE PANAMA CANAL
Canal Zone in broken lines

The lowest part of the Sierras of Central America occurs at Panama, which is also the narrowest part of the isthmus. Panama naturally became the chief pass, therefore, between the Atlantic and the Pacific; and the mule-route was later followed by the railway. The chief barrier, however, is the unhealthy climate, which caused the disastrous failure of De Lesseps' attempt to cut a canal. In 1914 the Government of

the United States completed the abandoned work at a cost of £100,000,000. The canal was cut from Colon on the Atlantic to Panama on the Pacific, a distance of about thirty miles. Like the Suez Canal, it runs for part of the distance through an artificial lake, and also it is a bottle-neck through which the ships of the world now pass. Unlike Suez, it is not a sea-level canal, but first rises and then descends by a series of locks or water steps.

The completion of the Panama Canal is the most important political and economic event in the history of the Pacific. The chief effect has not been to bring Asia or Australia closer to Europe, but to bring the Pacific coast of both North and South America into closer touch with all North Atlantic regions and, in particular, with the Atlantic coast of North America. It has already had a very marked influence in stimulating the trade of California, and in forcing on the development of the Pacific side of South America.

BIBLIOGRAPHY TO PART VII

Smith, J. Russell. *North America: Its People and Resources*, 1924. (G. Bell & Sons.)

Greeley, A. W. *Handbook of Alaska*, 1925. (New York.)

B.A.A.S. *Handbook of Canada*, 1927.

(Contributed.) *Canada*, in vol. iv. of the Oxford Survey of the British Empire. (Clarendon Press.)

Lewis and Miller. *Economic Resources of the Pacific North-west*, 1923. (Seattle.)

Wickson, E. J. *Rural California*, 1923. (New York.)

Murphy, T. D. *Seven Wonderlands of the American West*, 1925. (Boston.)

Schnitzler, H. *The Republic of Mexico*, 1926. (Hutchinson.)

Elliott, L. E. *Central America*, 1924. (Methuen.)

PART VIII
SOUTH AMERICA

Chapter XXXIII
GENERAL SURVEY OF THE PACIFIC COAST

1. *Relief*

The lofty western mountain system of South America is the longest and most continuous fold-line on the earth's surface. Running in an unbroken ridge from Trinidad to Tierra del Fuego, it wholly determines the character of the Pacific coast region. This, however, is a very general and also very inaccurate description of the great Andean system. More truly it may be said to take the form of a vast elongated plateau, nearly everywhere more than 10,000 feet above the level of the ocean and having an eastern and a western rim which rise another 8,000–12,000 feet above the floor of the plateau. In Bolivia and Southern Peru, where the plateau is highest, it also opens out to its greatest width, and behind the great inward curve of the coast-line to Arica, it reaches a maximum width of about 200 miles. Occupying a depression in the floor of this plateau is the remarkable Lake Titicaca, a long sheet of fresh water over 10,000 feet above sea-level. The Pacific rim of this plateau has been associated with strong volcanic activity which has piled up lofty cones throughout its whole length. 'Tronador and Aconcagua, El Misti in Peru, and Chimborazo and Cotopaxi in Ecuador are simply outstanding examples of the hundreds of volcanoes, active, quiescent or extinct that overlook the Pacific from the heights of the Western Andes.' South of the Bolivian plateau the cordillera falls away; but, with distance from the equator,

glacial action becomes more marked, and the mountain wall is broken in several places by transverse valleys.

Every aspect of South America on its Pacific side must be studied with reference to the general control exercised by the Andean system. The chief feature from the human and

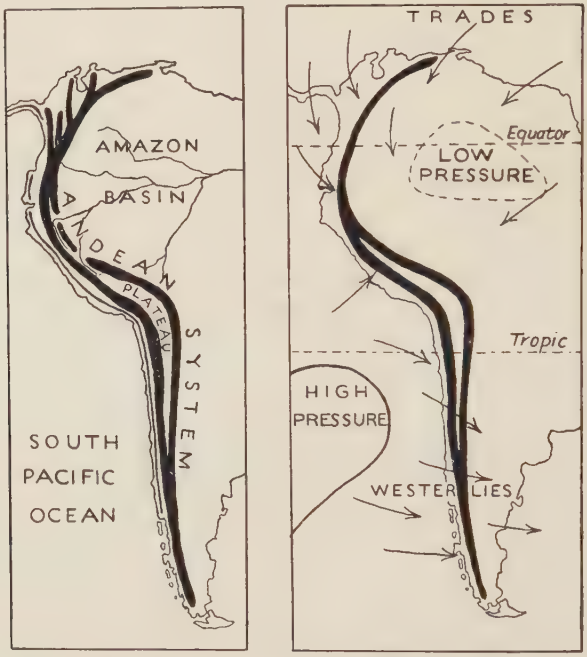


FIG. 165. WESTERN SOUTH AMERICA, PHYSICAL AND WINDS

economic side, however, is not so much the height of land known as the Western Cordillera which runs parallel to the coast and about 100 miles inland, but the coastal range which develops in southern Peru, fronts the ocean steeply for 1,500 miles along the coast of Chile, and becomes submerged and detached as the ragged chain of islands farther south. As a consequence of this arrangement of parallel folds, coastal

plains are either very narrow or entirely absent along the Pacific slope.

The moister conditions associated with the plateau, or rather with the Eastern and Western Cordillera rims, have developed erosion on the plateau more than on the Pacific slope. The floor of the plateau of Bolivia and southern Peru, in particular, is occupied by great quantities of alluvial

FIG. 166. SECTIONS ACROSS WESTERN SOUTH AMERICA

material washed down from the Cordilleras; and this alluvial soil forms the basis of the great upland pastures and of the cultivation which irrigation makes possible there. Loess formations similar to those of north China are also common. The Western Cordillera descends so sharply to the Pacific in the northern half of the continent, and climatic conditions are so arid over such a great part of its western slope, that the coastal rivers are merely seasonal streams; and more often lie in ravines carved in barren hill-sides rather than in valleys. In strong contrast, the foot-hills on the landward side of the Eastern Cordillera are the forested upper slopes of the great eastward flowing rivers known as *yungas*. To the north, in

western Colombia and Venezuela, the whole system flattens out and breaks off into divergent chains.

2. *Climate*

The climatic regions depend wholly on the relation of the Andean highlands to the great wind systems. Every variety

FIG. 167. CERRO PUNTIAGUDO

One of the many volcanic peaks scattered along the Andean ridge

of climate is to be found in the mountain area, or on the lower levels of the plateau or coastal valleys, and often the change from equatorial to arctic climate is possible within a hundred miles owing to differences in elevation. Nevertheless, a broad classification into regions is comparatively easy. To the north the Pacific coast of Colombia and Ecuador comes entirely under the influence of tropical conditions, and this area conforms fairly closely to the regular equatorial type. The lower slopes are densely forested with tropical vegetation, while plants and trees of temperate climate habit are found at

higher levels; and almost every vegetable product from cocoa to rubber is possible.

The whole of the great continental block north of the Tropic of Capricorn is dependent upon the Atlantic wind system for its general rainfall; and consequently the western coast, which is here the lee side, tends to be dry. This is

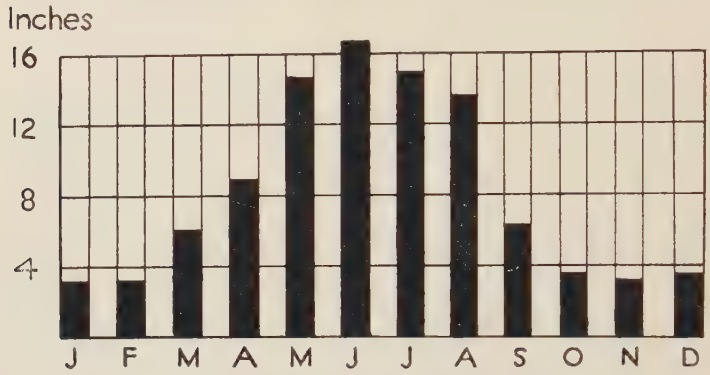
FIG. 168. ON THE BOLIVIAN PLATEAU NEAR LAKE TITICACA

Notice the Andean rim in the distance, the Spanish architecture and the Indian women engaged in knitting

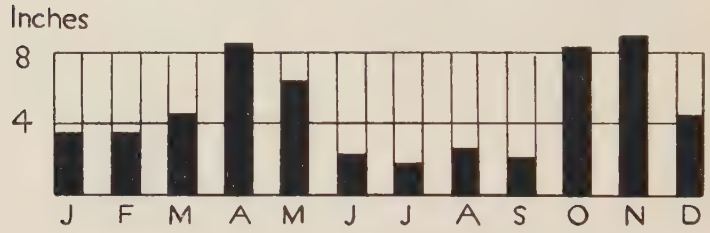
intensified by the action of the cold Humboldt Current which runs north along this coast. On-shore winds are cooled as they pass over this cold ocean surface, and when they reach land and become warmed they tend to absorb rather than to deposit moisture. These two factors explain the north-south extension of the arid region which reaches its climax in the desert of Atacama.

In the broad plateau area of Bolivia and southern Peru the climatic regions are in the nature of parallel strips, running, of course, north and south. These may be broadly sketched

as: (i) The eastern slopes, warm to hot with rainfall up to 40 inches per annum but somewhat unreliable. In general the region is not favourable for agriculture. (ii) The Cordillera region, a bare sub-arctic area which is only populated where



Rainfall for Valdivia, west coast winter rain region



Rainfall for Bogota, Colombian montana

FIG. 169. RAINFALL, SOUTH AMERICA

the great mineral wealth is sufficiently accessible to compensate for the hardships. (iii) The plateau proper, characterized by clear, cold weather with little rainfall. Here agriculture becomes possible through irrigation, but only hardy temperate plants such as the potato and barley can be grown. There is never sufficient heat to ripen crops such as maize

or wheat. The chief occupations are therefore pastoral, and the natives rear sheep and the typical animals of the region, the llama and the alpaca. (iv) The Pacific slope, warm and dry, with great possibilities for valley agriculture under irrigation.

After an intermediate region in the latitude of the Atacama Desert, the direction of the wind control is reversed; and farther south the mountainous west coast is opposed to the Westerlies. This produces along the coast of north Chile the true Mediterranean winter-rain conditions, and for south Chile the excessive rainfall which produces temperate forest, but is unfavourable for agriculture. The dry-belt is now found on the eastern side, and the conditions are strictly comparable to those in Tasmania and the South Island of New Zealand. The upper levels here form a great glacial field which merges, lower down, into swampy valley or water-logged plateau, and the region is practically uninhabited. Even on the drier east side conditions of life are very difficult, and only in the warmer situations does pasturing of sheep become possible.

3. *People and Industries*

South America has not proved an easy country for development. As barriers to settlement by the white races, the tropical climate and luxuriant vegetation of the eastern lowlands are equalled by the lofty and inaccessible mountain plateaux of the west, and by the desert strip which in great part separates them from the sea. Nor has the development of the country been assisted by the presence of numerous and vigorous native peoples. The Indians of South America, a people racially allied to the Reds of the northern continent, are, in contrast, a primitive and spiritless people, composing three-quarters of the population of the Pacific regions of South America. They belong to two main branches, viz. the backward Aymaras (pron. Eye-mah-ras) and the livelier

Quechuas (Kesh-wahs) of the lower levels. Accustomed to servile obedience to overlords from the days of the Incas, the Emperors of Old Peru, their experiences under Spanish rule, and later under that of the republics, have done nothing to advance these folk in the scale of civilization. 'The Aymaras' existence', says a writer, 'has been a continuous struggle against the environment of the bleak and inhospitable plateau, against hunger, cold, and the lack of oxygen,' and (he might have added) against inept governments. Living in an unfurnished stone- or mud-hut, wearing the poorest of woollen clothing and crude sandals when he is not barefoot, and existing on a diet of potatoes or rough barley bread, he is the labourer of the High Plains, the porter of the small towns and villages, and the drover of the mules or alpacas on the pack-routes between the mines and villages, living almost the life of the animals in his charge. The Quechuas are the most numerous element in the country by far. They are the agricultural labourers, the miners, the serfs or *peons* of the ranches and plantations, sold with the land, esteemed very little higher than the stock they tend and owning almost no political or social privileges. In the Andean zone proper there are probably some ten millions of Indians, who form a body of serfs incapable of owning land, without ambition, and restless to the point of becoming a danger to established government at any time. In addition to the Indians there is a very large half-caste element of mixed Spanish and Indian blood, known as *mestizos*. These are in general a more intelligent and progressive, if more mercurial and unreliable, section of the population. The landowning and governing class is composed of the descendants of the Spaniards who came to these lands after 1500 in search of gold. The man of this class is sometimes a progressive pastoralist or careful farmer, but is more often an absentee landlord favouring the tradition of the grandee living in the towns on the income from his estates. There is a considerable difference, however,

between the active and intelligent desire for progress in Chile and southern Peru, and the chaotic and often anarchic conditions in some of the other republics. The *mestizo* is the chief hope of the future since he combines intelligence to appreciate new methods, with a constitution adapted to the rigours of the climate in the highlands.

FIG. 170. CHUNCHU INDIANS

On the Rio Peréne, montanas of Peru. Note the curious robe and the punt-like craft

Unstable government is the chief curse and greatest barrier to progress in all the Pacific republics with the exception of Chile. But the extension of railways, and the control exercised through foreign capital invested in mines, railways, and plantations, must in time have a steadying influence. For any advance in methods of production, too great a proportion of the population has still to be used as mere carriers, owing to the nature of the country and the difficult mountain routes. This had an isolating effect that made Bolivia, in particular,

almost the Tibet of South America; and parts of Peru were very little better; and this condition will only disappear with the provision of roads and railways.

4. *Minerals*

The wealth and extent of the mineral deposits were the real cause of the Spanish invasion of South America. The vast quantities of gold and silver exported since the Spanish occupation have not resulted in any benefit to the countries producing them; but, on the other hand, have rather tended to keep the plateau regions in a state bordering on savagery. But the modern phase of mining development has given more attention to the deposits of minerals other than those of gold and silver; and the need for labour has forced attention to the condition of the labourers.

The chief difficulties in these days are connected with smelting of the ore and transport to the coast. Vast amounts of copper, tin and mercury have been taken from the plateau regions even before the advent of the railway; but the import of capital, the extension of railways, and the development of the ore-bodies by large-scale methods is having an enormous effect from one end of the Andes to the other. Gold-mining is now comparatively unimportant; and silver is important only through its association with other minerals, in Peru with copper, in Bolivia with tin. The chief production for the whole region is now that of copper, of which metal a rich zone runs right through the Bolivia-Peru plateau. Large smelting works in central positions now draw the ore supplies from the mines by rail; in fact the railway is the key to mining, as it is to farming development, throughout the continent.

Other rich zones occur in Bolivia where tin, silver, bismuth, and tungsten are mined. The Andes are almost the sole source of supply for two very important minerals in platinum

and vanadium. The first is obtained from the river gravels of western Colombia, and the second from an elevation of 16,000 feet in Peru, where 80 per cent. of the world's supply is mined. Peru is also an important source of supply for

FIG. 171. THE CENTRAL RAILWAY OF PERU BREAKING THROUGH THE ANDES

The engineer has been forced to substitute a succession of Y-switches for curves

mercury and lead. It is estimated that Chile alone has enough sulphur in the craters of the mountain section, and borax in the *salars* or salt-flats, to supply the world with those commodities for centuries to come. The mineral areas are chiefly in four sections: (i) the region served by the Central Railway in Peru; (ii) the Eastern Cordillera in Bolivia; (iii) the Cauca Valley and the adjacent Pacific slope in Colombia;

FIG. 172. COLOMBIA AND ECUADOR

and (iv) the Andean area of northern Chile. Dr. E. W. Shanahan has said:

'In no comparable region in the world have such quantities and such a variety of igneous rocks been forced through the crustal formations at such numberless points both in the flanks of the ranges and at their summits; nowhere else have the minerals brought up to the surface been so well preserved from the action of denuding forces as in the Central Andes; but in no other highly mineralized region do most of the ores lie at such high altitudes or in such bare and wild mountain country as they do from Ecuador to southern Chile. Even within the tropics many of the richer deposits are situated quite near the snow line, sometimes, as in Bolivia, on rugged spurs between the glaciers.'

Chapter XXXIV

COLOMBIA AND ECUADOR

1. *Physical*

To the north and south of the mountain knot in southern Colombia the character of the Andes is very different. On the north they fall away to the Pacific or to the Atlantic in a series of diverging ranges; to the south they assume the broad plateau formation of Peru and Bolivia. The Western Cordillera is broken by comparatively low passes in Colombia; but in Ecuador it offers such a barrier to transport from the Pacific that the railway from Guayaquil has to climb nearly 11,000 feet to reach the plateau. In Colombia two great ranges swing away from the Pacific towards the north-east. (Of these the West Indies are a partly-submerged extension.) Valleys thus open out which allow the incoming ocean influences access far into the interior, a great contrast to the conditions farther south. The Central American chain, which forms the Panama bridge, is a low range, structurally quite distinct from the Andes.

The mountain fold close to the Pacific, known as the Coastal Range, is here much higher than it is farther south; and is a barrier sufficiently high to divert the streams to the northward. This arrangement of the highlands breaks the drainage into three systems, viz. the Pacific, Caribbean, and Atlantic rivers. On the western slope the Daule, S. Juan, and Atrato rivers have eroded considerable valleys before breaking through the Coastal Range to the sea. In contrast to the raised coasts of Peru and Chile, the Pacific coast of Colombia and Ecuador has sunk and drowned the lower valleys of these rivers, forming the only estuaries on the western side of the continent.

To the west and north of the maritime ranges lies a distinct geographical region, the coastal lowlands, varying from a mere strip 15–30 miles wide, to the much extensive swamps round the estuaries where mangroves predominate. Farther back, the slopes and upper valleys comprise the main agricultural areas. This well watered but empty coastal district offers a striking contrast to the arid Peruvian coast, where every foot of irrigable land has been occupied.

On the other side of the plateau are the foot-hills dropping away to the upper basin of the Amazon, and drained by many large tributary streams. This region, known as the *montana*, has every circumstance of elevation and climate in its favour; but its great distance from the Atlantic has maintained a condition of undeveloped isolation even more marked than that upon the enclosed tablelands of the Andes. The montana of Peru and Bolivia is comparatively easy of access, however, along the main and tributary streams of the Amazon; but the rapids along the rivers serving the montana of Ecuador and Colombia complete its isolation. The interior of the north-western section of the continent is, in fact, faced by a rather tragic dilemma. Transport must take either the shorter but very difficult route through the Andes to the Pacific, or the longer way across the swampy lowlands to

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the Atlantic. Further, many of the longer rivers, which would offer the natural route, are broken by gorges and rapids to such an extent that the people in the upper valleys turn to the Pacific of necessity in all matters of transport and trade. Economically these become Pacific regions. The upper Cauca valley of Colombia, in particular, is accessible from the Pacific port of Bonaventura through a comparatively low pass 5,000 feet above the sea, which therefore becomes the outlet for a rich agricultural and mining region on the opposite side of the ranges.

2. *Climate and Vegetation*

Almost the whole of the northern section of the continent is a summer rainfall region rather monsoonal in character. But the arrangement of the mountains, and the continuous indraught from the ocean to the land caused by the presence of such a great land-mass so near the equator, affects the rainfall; and, in consequence, the winter drought is not clearly marked. This applies to the Pacific coastal area particularly. The average temperature over the coastal lowlands is high, below 6,000 feet averaging 80–90° for most of the year. This rain and heat brings the forest belt right down to the shore-line. Such a climate is most unhealthy for Europeans, and the dense jungle-growth is a serious barrier to the development of the country. It is not surprising, therefore, that settlement is confined to the higher levels where rainfall is less, the forest thinner, and the land better drained than nearer the coast.

The luxuriant growth of the tropical forest is, however, confined roughly to the coastal areas and to the lower valleys and slopes. At levels exceeding 5,000 feet this changes to the type of forest usual in temperate climates; and it is everywhere less dense than in the lowlands. The plateau areas at 8,000–10,000 feet are grasslands with very little tree

growth. The whole Pacific slope in Colombia and Ecuador, it should be noted, is a forest region and distinct in every particular from the slope farther south.

3. *Production*

'Such conquest of these tropical shore-lands as has been effected by man', writes Dr. Shanahan, 'has been at great cost of life, and has been singularly incomplete.' Conquest of tropical conditions has not been carried to the lengths attained in Malaya or West Africa; and the reason is not far to seek. Almost everywhere, in lowlands and uplands, the forest makes settlement dependent upon great effort. But life is easy where foods like the banana, the coco-nut, and mandioca are so abundant; and in such a climate it is difficult for white and coloured people to maintain a sufficient output of energy.

But the tropical lowlands of South America on the Pacific slope have shared in the greater attention that the world has been paying in recent years to its equatorial regions. The exploitation of the rich mineral deposits, which were the main attraction of the interior for Europeans, made some survey of the coastal area a necessity; and so a desultory sort of settlement followed. Later, Europe's need of sugar forced on the cultivation of some districts; but that is about the full extent of settlement at the present time.

The inland slopes, facing the incoming rain-bearing winds, have a better record. Here are found the best conditions for many kinds of tropical agriculture, and the climate is more tolerable for both whites and Indians. In particular, it forms the ideal environment for the cultivation of cacao. This plant, because of its heavy pods, must be sheltered from strong winds; and it also needs abundant rain, uniformly high temperature, and fertile soil. It also requires shade, and this is obtained by growing it alternately with bananas. Ecuador and Colombia

contain the largest area of land offering such conditions; but since the cultivation and preparation of cacao demand such an amount of careful labour the premiership in this industry has passed to West Africa. The 'go-as-you-please' attitude of parts of South America is in fact responsible for the loss of one industry after another. Production of all kinds from rubber to sugar, and from cinchona to nitrates, is passing more and more to areas not so well fitted by nature.

FIG. 173. CACAO PLANTATION

Note the plantation in the background with rows of shade-trees, the drying-shed, and the labourers gathering the heavy pods. Wind is the great bugbear of the cacao planter

Coffee, produced at 3,000–6,000 feet, has been more successful in retaining its hold in the world's markets. Some cotton is grown in the lowlands of Ecuador. Mandioca, the staple food of the people, is a starchy food produced from a root native to the region. From it a flour, *farina*, and the tapioca of commerce are prepared. Conditions for rice are ideal in the lowlands, but little is grown. Coco-nuts and bananas grow wild in great profusion; but the production of copra is unimportant and the West Indies are much nearer the fruit markets of Europe. Forest wealth is, of course, considerable, but scarcely touched as yet. Tagua-nuts, the source of

vegetable ivory; mangrove bark and other tanning materials; rubber, chicle (the gum of the zapote-tree, the chief constituent of chewing-gum), mahogany, and other timbers are all important products. In the eastern foot-hills coca leaves and cinchona bark are valuable products yielding cocaine and quinine, two most important drugs. But the production of rubber and cinchona is declining in value owing to the production on the great plantations on the other side of the Pacific.

People

The population of Colombia and Ecuador is scattered; and the greatest concentration occurs in the plateau and the coastal regions. The plateau is everywhere an important stock-raising and agricultural region; but, owing to its isolation, a certain independence of the outside world is noticeable. Mining, especially for gold, was formerly a valuable industry, but is now declining. The coastal population is chiefly engaged in tropical agriculture or trade; and an oil-field is worked in Ecuador. Some ports, such as Guayaquil, serve a hinterland in Ecuador reaching right back to the plateau or even to the montana. Others are the outlets for a very limited stretch of coast-land. *Bonaventura* is the only Pacific port on the Colombian coast. The plateau towns, *Quito* and *Riobamna* in Ecuador, *Bogota*, *Medellin* and others in Colombia, occur in a long line at elevations of about 10,000 feet; and are supported by the pastoral and agricultural industries of the area.

Chapter XXXV

PERU AND BOLIVIA

1. *Peru*

The republic of Peru comprises half-a-million square miles stretching from the steep Pacific slope right across to the valley of the Amazon. There are thus three contrasted climatic regions within its boundaries, viz. (i) the semi-desert belt along the Pacific front, 1,400 miles in length and 50 miles wide, with the irrigated valleys of the short coastal rivers situated like oases along the barren slope; (ii) the plateau proper, which has already been described; and (iii) the forested slopes of the Amazon Basin which make up half the surface area of the country. Peru, with the exception of this third area, is practically a rainless region, lying as it does in the lee of the Cordillera, sheltered from the rain-bearing winds from the Atlantic. Only by irrigation, made possible by the melting snows on the Cordillera, can agriculture be carried on even in the valleys.

Peru has a peculiar and melancholy interest because of the ruthless destruction of the old Inca civilization found here by the Spanish adventurers in the sixteenth century. The ruins of the great stone buildings and causeways are a majestic reminder of the level reached by these people in the arts, as the irrigation channels and terraced mountain sides are still a tribute to their skill in agriculture. Of the present population $2\frac{1}{2}$ millions are descendants of the Indians, while $1\frac{1}{4}$ millions are *mestizos*. Half-a-million whites, chiefly of Spanish descent, 100,000 negroes who are descendants of slaves imported in past times, and 50,000 Chinese and Japanese complete the population picture. The Europeans, other than Spanish born in the country, live mostly in the ports, where they are engaged in trade or the administration of mines or plantations.

The productions of the country consist chiefly of the

petroleum and plantation crops of the irrigated coastal areas, the minerals and wool of the plateau, and the timber and subtropical products of the montana around the headwaters of the

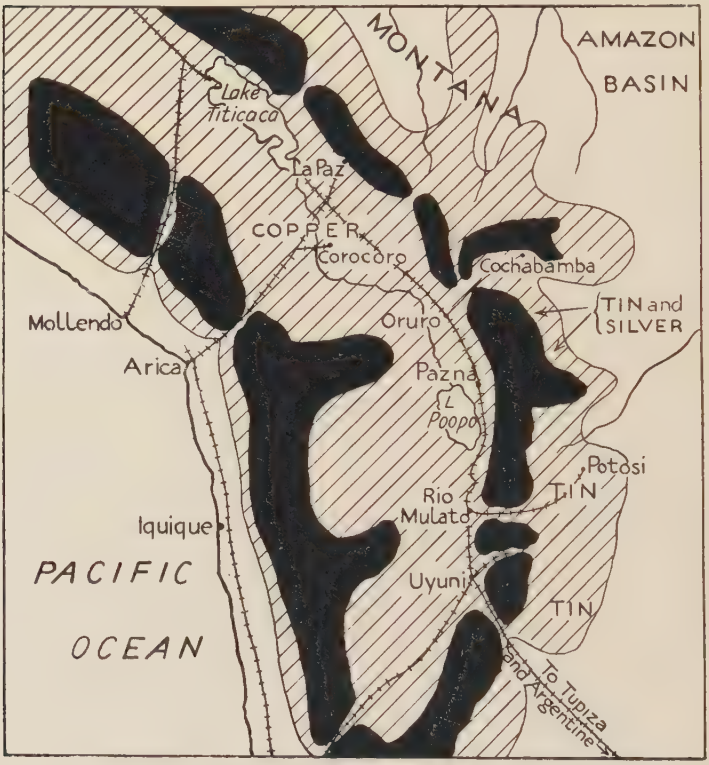

FIG. 174. PERU AND BOLIVIA, MINING REGIONS

Amazon. The cultivated valleys are a mere 1,000 square miles in extent; but they, nevertheless, produce 60 per cent. of the country's agricultural output. Irrigation is the chief concern of the Government; and such schemes as that involved in taking a river through the Cordillera by a tunnel 18 miles in

length to irrigate a further 500 square miles of territory sufficiently illustrate the difficulties of the country. Sugar is the chief crop of the country, mainly produced on large plantations in the coastal valleys north of Lima, of which Trujillo is the chief centre. The crop represents one-quarter

FIG. 175. TWO NATIVES OF THE PLATEAU

An Indian of Peru with his llama

of the value of all exports. Cotton was a staple crop in Peru in the days of the Incas, and is a native of the region. The main crop now is the Egyptian variety, which is grown mainly in the valleys south of the sugar belt with *Piura* as the hub of the region. In the zone intermediate between sugar and cotton, rice, Mediterranean fruits, bananas, and cassava are produced. On the higher levels of the plateau most temperate climate fruits and grains are grown to some extent.

Peru yields also a wide range of most important products such as petroleum, copper, silver, gold, vanadium, and guano, and about enough coal for the railway and smelting needs of the country. Since the decline in gold- and silver-production, copper ranks first among the metals. Venezuela and Colombia both produce more petroleum than Peru, but

FIG. 176. ON A GUANO ISLAND OFF THE PERUVIAN COAST

One of the effects of the Humboldt Current that carries the food that feeds the fish that attract the birds that leave the deposits that originated the industry that Jack and his donkey built

its output is quite important, totalling 10,000,000 barrels in 1927. Most of the world's supply of vanadium, a metal used as an alloy in producing steel of light weight and great strength, used particularly for motor vehicles, comes from Peru.

The cold Humboldt Current, which is so largely responsible for the arid condition of the western slopes, compensates to some extent by bringing northward a great wealth of sea-life, which in turn attracts vast numbers of sea-birds. These birds, over long ages, have built up the great guano deposits

which are now so important as fertilizers in the farming countries of the world. The long-standing dispute between Chile and Peru concerning the possession of the northern nitrate area has now been settled by a treaty which gives Tacna to Chile in return for £1,200,000.

Peru has no less than thirteen towns of over 15,000 people.

FIG. 177. SUNDAY MARKET IN HUANCAYO, PERU

Note the houses, the striped blanket worn by men and women, the donkeys, and the primitive drainage

The most important of these are: (i) Lima, Callao, Trujillo, and Piura in the coastal belt; and (ii) Cuzco, Sicuani, Arequipa, and Cerro de Pasco on the plateau. *Lima* (220,000), an old city in the Spanish style, is both capital and commercial metropolis. It has many factories and handles most of the business of the country. *Callao* (66,000), 8 miles to the south of Lima, has the best harbour on the Peruvian coast, and conducts 50 per cent. of the country's trade. A factor in its importance is the railway to the great copper-producing area

of Cerro de Pasco. *Mollendo*, the second port, is the terminus of the important route via Lake Titicaca. Transport over the whole region is tremendously difficult and still depends largely upon trains of mules and llamas; and this adds to the importance of the sea-routes and terminal ports.

2. *Bolivia*

Strictly speaking, Bolivia is not a country belonging to the Pacific Basin, since the natural drainage is to the centre of the plateau or towards the Amazon Valley. Even the plateau area is barely 40 per cent. of the country, the other 60 per cent. falling along the montanas on the east here called *yungas*. Yet, since three-fourths of its people turn towards the Pacific in trade and communications, we are justified for our purposes in embracing this area in our survey. The comparison between Bolivia and Tibet is particularly appropriate. The difficult nature of the country in general, and especially of the Cordilleras on the eastern and western rims of the plateau, has produced an isolation that is broken only by the infrequent railway and the inadequate mule-train. The plateau produces insufficient food for the inhabitants; it is scourged by cold winds; it suffers a long and bitter winter that prevents the cultivation of all but the most hardy crops and makes forest growth impossible; and conditions generally are hostile to human progress. Since three-quarters of the population make a living here, Bolivia for the purpose of our study is the plateau region.

The chief occupations of the people are concerned with pasturing their hardy flocks of sheep, alpacas, and llamas, with the little and unsatisfactory agriculture, or with mining. If petroleum is ultimately found in commercial quantities this may help the country's development, but always and everywhere the great barrier is the difficulty of transport. The 1,300 miles of railway in the country are mostly on the plateau,

linked to the ports of Mollendo, Arica, and Antofagasta, through which 90 per cent. of the trade moves.

The montana region has large areas of grassland which pasture considerable numbers of wild cattle. Maize, sugar, coffee, cotton, and tobacco are cultivated; and a curious industry is the gathering of coca leaves, the main use of which by the natives is for chewing as a narcotic. The exports of Bolivia in order of value are tin, silver, rubber, copper, lead, bismuth, zinc, and antimony. *La Paz* (118,000) lies in a sheltered position in a deep valley 1,500 feet below the floor of the plateau. It is the commercial metropolis, and a modern city with electric services of all kinds. Its chief importance comes from the neighbouring tin-mines. *Oruro* (30,000) is the collecting centre for the tin and silver of the central area, and is on the main plateau railway. *Potosi* (30,000), once the greatest silver-producing area of all time, is now of declining importance. *Cochabamba* (31,000) is the second city and the centre of one of the best agricultural areas. *Sucre* (12,000) is also dependent on the surrounding agriculture and pasture.

Chapter XXXVI

CHILE

1. *Physical*

In more senses than one Chile is China's opposite number. In place of a compact block of country we have in Chile a long thin strip of country that is remarkable for the differences it presents. Chile has been called by Dr. Shanahan a 'land of contrasts' and the label fits the country exactly. Its extreme length of nearly 3,000 miles, i.e. about the width of Australia, contrasts with its narrowness of less than 100 miles, or half the width of Tasmania. The hot, rainless desert in

the north contrasts with the cold, rainy desert of the south. Again the mining of the north, which is the main occupation, contrasts with the farming of the central regions in a remarkable way.

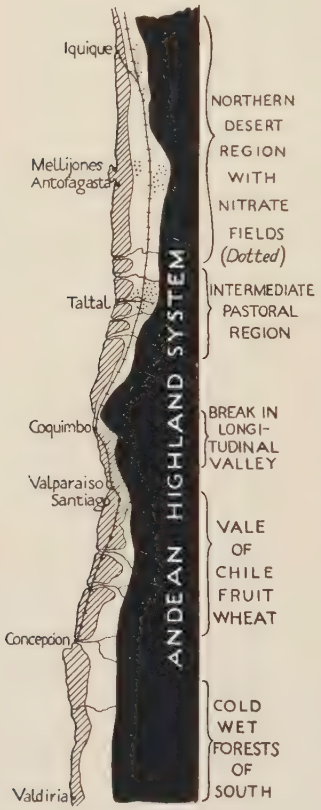

FIG. 178. CHILE

The whole character of the country is determined by the broad belt of the Andes which sweeps down the whole length of the country, more as a definite range than as the series of broad plateaux it presents to the north, falling gradually in elevation to the extreme south. The mountain wall, too, is here more broken by passes, although for various reasons the east-west traffic is very small. Farther to the west of the main range the land finishes as a very definite rim known as the Coastal Range. This rim rises to heights of 7,000 feet, but to the south of Valdivia it dips to become a fringe of islands or a fretwork of fiords very similar to the formation found in the south-west corner of New Zealand. This Coastal Range, however, exercises an influence on the country out of all proportion to its height.

By far the most important feature of the country, at least from an economic point of view, is the long narrow depression lying between the Andes and the Coastal Range and known as the Vale of Chile. This is not properly a valley at all, but

a great terrace of alluvial material carried down from the Andes and held back by the coastal retaining-wall. This filling of sediments forms at once a great plain, more or less level, and a bed of fertile soil which is the basis of the country's agriculture. The coastal rim has been gradually raised in the past, but the rivers have been able to cut down faster than the land rose and so they run in all cases across the Vale of Chile and break through the Coastal Range by gorges. Elevation, in fact, is still in progress; and the raised beaches of the coast-line together with the frequency of earthquakes show what a young country this is in a geological sense. Earthquakes occur at the rate of two a day, but only about two a year have proved very destructive. The central valley is by no means a continuous depression. Bisected into north and south sections by a hilly region north of Santiago, it loses for some distance the character of a valley altogether. In contrast to the Californian coast, harbours have not been formed where the sea-wall has been breached, because of the high level of the Vale of Chile. The southern section of the Vale contracts here and there to mere defiles between the Andes and the Coastal Range.

2. *Climate*

Climatic regions in Chile are very clearly marked. To the north is that area which comes under the influence of the prevailing high-pressures—the true trade-wind desert region, where rain falls very seldom and never in any quantity. Farther to the south this gives way to a zone affected during the cold months by the cyclonic influences of the west-wind region, and having a marked winter rainfall and summer drought. That part of the Vale of Chile coming under these weather conditions has become the 'garden of Chile' and is, indeed, very like California in most respects. All the typical Mediterranean plants are to be found growing in this area, most of them, of course, having been introduced. The natural

vegetation is a series of beeches, laurels, and cypresses. Farther to the south the excessive rainfall, 100 inches and more during the year, results in a heavily-forested region where Chilean pine mainly predominates.

In central Chile, as in California and in the similar climatic regions of southern Australia, settlement has proceeded along the river valleys wherever irrigation can be practised. In southern Chile, on the other hand, the excess of moisture has

FIG. 179. THE HARBOUR, CALLAO

One of the typical exposed ports of the Pacific Coast of South America

left the country largely uninhabited, although other factors in the situation are the prevailing low temperatures and the poor soils. Another curious contrast which should be noticed is that, although the settlements in the irrigated valleys 'suffer from time to time through lack of water in their supporting streams, and through failure in their average scanty rainfall, their worst enemy is floods which either sweep away the inhabitants' crops and belongings, or still worse, strew their fields with thick layers of pebbles and debris brought down from the mountains above'. Seventy per cent. of the population of the country is supported on the three million acres of these irrigated lands in the Vale. The ranges boast

very little plant life, although considerable flocks are pastured in the grassy uplands, as well as in the belt between the desert region and the irrigated areas.

3. *Occupations*

Following the climatic zoning of Chile, a similar division of industries dependent upon the land is to be expected. Mining,

FIG. 180. A NITRATE OFICINA

On the Antofagasta field, North Chile. The huge beds of caliche, i.e. workable deposit of nitrate, are treated in this way for the recovery of the nitrate and iodine. Water carrying salts in solution was caught ages ago in isolated basins, and evaporation then left the great deposits. Nitrates now support 250,000 people in a treeless, waterless region where everything, even soil, must be imported

pasture, farming, and forestry succeed each other from north to south of the country in that order. Some variation to the regular succession is caused by the rise in level towards the Andes; and, in general, mining for metals is confined to the mountains as it is in Peru and Bolivia. Mining is the dominant industry of the country. Chile is the world's main source of supply of nitrates and iodine, and the second source of supply copper. Coal and iron are also largely mined, the latter being an important export.

Chile's chief export, nitrate, deserves a special note. Nitrate of soda, carried down for long ages in solution by the streams from the Andes has, by evaporation in the dry desert climate, been deposited along the margins of the *salars* or salt-basins. In the great expansion of agriculture during the last century, and the need for feeding quickly-growing populations, the world has found that these nitrate deposits are invaluable. Phosphorus, potassium, and nitrogen are the three great foods demanded by plant life. Continuous cultivation of the soil exhausts these constituents, which have to be replaced in the form of fertilizers. Consequently most farming countries are concerned over the supply of fertilizers, especially of nitrates. In 1913 the farms of the world consumed 750,000 tons mainly from Chile. In 1928 they consumed 1,500,000 tons, but recent developments in extracting nitrogen from the air by electrolytic processes may diminish the importance of Chile's nitrate mines.

BIBLIOGRAPHY TO PART VIII

Shanahan, E. W. *South America: An Economic and Regional Geography*, 1927. (Dutton & Co.)

Whitbeck, R. H. *Economic Geography of South America*, 1926. (McGraw Hill.)

Jones, C. F. *Commerce of South America*, 1928. (Ginn & Co.)

Elder, P. J. *Colombia*, 1925. (T. Fisher Unwin.)

Enock, C. R. *Ecuador*, 1924. (T. Fisher Unwin.)

Enock, C. R. *Peru*, 1925. (T. Fisher Unwin.)

Walle, Paul. *Bolivia*, 1923. (T. Fisher Unwin.)

McGovern, W. M. *Jungle Paths and Inca Ruins*, 1927. (Hutchinson.)

Dell, A. *Llama Land, Peru and its People*, 1927. (Geoffrey Bles.)

Elliott, G. F. S. *Chile*, 1926. (T. Fisher Unwin.)

Edwards, A. *My Native Land*, 1928. (Benn.)

Bowman, Isaiah. *Desert Trails of Atacama*, 1924. (Amer. Geog. Soc.)

Hunter, I. A. (edit.). *The South American Handbook*, 1929. (London, S. Amer. Publications.) Contains an excellent bibliography.

INDEX

N.B. *References to the chief countries and regions will be found in the List of Contents.*

acacias, 82, 97, 123, 149.
Acapulco, 305.
Aconcagua, Mt., 5, 307.
Adelaide, 146.
Aldrich Deep, 151.
Aleutian Chain, 8, 16, 265
alpaca, 313, 330.
Altai Mts., 3.
Amalpa, 305.
Ambon, 84.
Amoy, 243.
Amur, 3.
Andes, 5, 307–13, 317, 332.
Aneityum, 183, 186.
Annam, 38, 222.
antimony, 182, 331.
Antofagasta, 331.
Apia, 196.
apples, 100, 138, 165 280, 287, 288.
apricots, 43, 138.
Arequipa, 329.
Arica, 331.
Arizona, 40, 297, 299.
Armidale, 127.
artesian wells, 40, 91, 113–15, 122–3, 150, 203.
Atacama Desert, 40, 311.
Atherton Plateau, 124.
atolls, 13, 14, 208–13.
Auckland, 42, 159, 173.
Austr. aboriginals, 109, 120.
Aymaras, the, 313–14.
Ayuthia, 227.
Ballarat, 135.
bamboos, 39, 235.
bananas, 82, 100, 124, 182, 193, 198, 204, 322–3, 327.
Bangkok, 227.
Banka I., 77.
Barkly Tableland, 119, 123.
barley, 23, 52, 254, 272, 280, 312.
Batavia, 36, 69.
beans, 76, 131, 226, 245, 254, 258, 262.
bêche-de-mer, 182, 206.
beeches, 47, 137, 164, 334.
Bellenden Ker Range, 124.
Bendigo, 135.
Bering Strait, 3, 16.
Berri, 144.
Billiton I., 77.
Bismarck Mts., 78.
bismuth, 301, 316, 331.
Blenheim, 175.
Blue Mountains, 129.
Bogota, 312, 324.
Bonaventura, 321, 324.
borax, 317.
Bougainville, 186.
Bourke, 24, 42, 123.
Bowen, 126.
bread-fruit, 82, 194, 211.
Brisbane, 123, 126.
Broken Hill, 115.
Brunei, 68.
Buckland Tableland, 126.
Bundaberg, 125.
Burnie, 141.
Burrinjuck Dam, 143.
butter, 173, 176, 250.
cactus, 110, 299–300.
Cairns, 124–5.
Calgary, 46.
Callao, 329, 334.
Camooweal, 123.
Canberra, 90.
Canterbury, 153.
— Plains, 158, 164, 168.
Canton, 243.
canyons, 129, 137, 268, 287, 294, 299, 300–1, 310.
Caroline Is., 11, 207.
Carson City, 299.
Cascade Ranges, 277, 285–6.
Cassilis Gate, 90, 127.
Castlemaine, 135.
cattle, 110–12, 119, 122, 126, 128, 132, 137, 166–7, 169, 280, 287, 297, 299, 304.
Cebu, 220.
Celebes, 16.
cement, 129.
Ceram, 16, 84.
Cerro de Pasco, 329.
Cessnock, 129.
Changsha, 239.
Charters Towers, 125.
cheese, 173, 176.
Chefoo, 243.
Chicago, 24.
Chieng Mai, 227.
Chillagoe, 125.
Chimbarazo, Mt., 307.
Chinese settlers and traders, 58, 65–6, 77, 80, 86, 193, 200, 205, 208, 219–20, 228, 240, 245.
Chinkiang, 239, 243.
Christchurch, 173.
Chungking, 239, 243.
cinchona, 70, 76, 324.
citrus fruits, 43, 100, 144, 198, 200, 204, 293.
Clarence R., 127.
climate, 18–55, 59, 68, 78, 86, 91–7, 102, 114, 119–24, 126, 137, 148, 150, 153, 158–62, 180, 181, 184, 187, 191–2, 194, 197, 201–2, 212, 215–16, 224, 230–2, 245, 248, 251–3, 271, 277, 279, 285–6, 289, 297–9, 301, 304, 308–13, 321–2, 325, 333–5.
Cloncurry, 123.
coal, 65, 77, 83, 125–6, 128–9, 133, 139, 175, 227, 241, 255, 276, 328, 336.
Coast Range, 273, 277, 285–6.
Coastal Range, 332.
Cobdogla, 144.
coca, cocaine, 324, 331.
Cochabamba, 331.
Cochin-China, 38.
cocoa, 76, 82, 193, 311, 322, 333.
coco-nuts, 62, 70, 82, 86, 119, 180–1, 185, 193–4, 198, 200, 204, 211, 213, 217, 220, 226, 304, 322–3.
coffee, 67, 70, 76, 82, 182, 198, 204, 323, 331.
Coleridge, L., 176.
Colon, 306.
Colorado, 298; Desert, 299; River, 300.
Columbia R., 285.
Condominium Pact, 185.
continental islands, 11, 13, 17, 178.
— shelf, 6, 7, 13, 55.
Cook Is., 11, 37, 190, 198.
Cook, Mt., 153, 155.
Cook, James, 183, 191, 199.
Cook's Strait, 153.
Coolgardie, 150.
copper, 67, 83, 123, 125, 146, 182, 227, 255, 276, 301, 316, 328–9, 331, 336.
copra, 66, 67, 76, 84, 181–2, 185, 188, 193–4, 196, 197, 200, 206, 217, 304.
coral reefs, 12–15, 18, 90, 179, 208–13.
Cotopaxi, Mt., 307.
cotton, 39, 43, 82, 105–6, 119, 128, 182, 226, 238, 260, 263, 323, 327, 331.
Cuzco, 329.
cyclones, 181, 216, 286.
dairy-farming (*see also under* cattle), 110, 128, 131–2, 137, 141, 143–4, 149, 157, 167, 169, 173, 249, 280, 296.
Dalny, 245, 250.
Darling Downs, 126–7.
— R., 141–4.
Darwin, 36, 97, 121, 123.
Dawson, 273.
— Valley, 125.
deforestation, 98–9, 147, 234.
depopulation, 33, 181, 186–8, 198, 207–8.
De Quiros, 183, 187, 191.
Derwent R., 136, 138.
deserts, 25, 40–1, 149, 245, 299, 304, 311, 313, 332–3.

Devonport, 141.
Doldrums, the, 37.
Dry Lands, the, 297–9.
Dunedin, 174.
earthquakes, 9, 251, 333.
Easter Island, 1.
Egmont, Mt., 156, 157.
Elephant Butte Dam, 302.
Ellice Is., 212.
El Misti, Mt., 307.
ensilage, 105.
Equatorial Currents, 28, 92.
erosion, 59, 89, 98, 180, 190, 235, 240, 249, 273, 289, 299, 300, 309, 320, 333–4.
Erebus, Mt., 4, 8.
Eskimoes, the, 19.
eucalypts, 43, 82, 97, 123, 128, 131, 137, 148, 293.
Eyre, L., 122.
Fakarava I., 210, 213.
Fiji Is., 9, 11, 13, 18, 36, 37, 191–3, 195.
fiords, 47, 154, 157, 268, 273, 332.
firs, 47, 99, 279, 281.
fish, 133, 141, 167–8, 224, 226, 236, 258, 269, 275.
flax, 163–4, 175.
Flinders Range, 91, 146.
Fly R., 78.
Foochow, 243.
forests, 47–9, 51–2, 55, 59, 61–3, 70, 73, 76, 82, 86, 97–9, 126, 130, 137–8, 148, 161, 163–4, 180, 216, 218, 248, 253–4, 256, 262, 271, 274–5, 279, 281, 297, 304, 310, 313, 321–2, 325, 334.
Formosa, 250, 262.
Franz Josef Gl., 153, 155.
Fraser R., 278, 285–8.
Fresno, 295.
Friendly Is., 11, 197.
fruit (*see also under names*), 70, 83, 100, 138, 143–4, 146, 149, 165, 173, 175, 193–4, 198, 255, 269, 288, 294, 297, 327; canning, &c., 203, 281, 294, 295; dried, 101, 295.
Fuji, 251.
furs, 49, 52, 271, 276.
Fusan, 262.
Galapagos Is., 9, 28.
Gambier Is., 213.
Geelong, 112, 135.
Gilbert Is., 11, 13, 212.
Gippsland, 131, 132.
glaciers, 5, 153, 155, 268, 272, 274, 286, 308, 313.
gold, 40, 65, 83, 120, 125, 135, 150, 173, 272–3, 276, 301, 316, 328.
Goulburn, 132, 143.
Grafton, 126–7.
Grand Canyon, 301.
grapes, 43, 128, 295.
graphite, 83.
grasslands, 50, 70, 78, 98, 105, 113, 123, 125, 128, 135, 142, 149, 156, 164, 168–9, 180, 216, 249, 287, 291, 297, 301, 304, 309, 313, 321, 331.
Great Barrier Reef, 15, 17.
— Divide, 4, 5, 128.
— Rift Valley, 91.
— Salt Lake, 297.
Guam, 207–8.
guano, 328.
Guayaquil, 324.
Gympie, 125.
Haapai Is., 197–8.
Haiphong, 228.
Hakodate, 46, 261.
Haleakala, 206.
Hamilton, 135, 175.
Hankow, 24, 42, 239, 243.
Hanoi, 228.
Harbin, 46, 245.
Hastings, 174.
Hawaii, 9, 13, 23, 37, 189, 194, 196, 200–6.
Hawaiki, 19, 31, 196.
Hay, 142.
hemp, 217, 220, 226.
hides, 66, 173, 182, 304.
Hilo, 206.
Himalaya Mts., 3, 229.
Hindu colonization, 56, 58, 74.
Hiroshima, 261.
Hiva-oa I., 208.
Hoang-ho R., 3, 17, 236, 237.
Hobart, 46, 140.
Hokkaido, 250, 255.
Hongkong, 242–3.
Honolulu, 24, 36, 205.
Honshu, 250.
Hood R., 287.
Hopi Indians, 40, 303.
hops, 47, 165, 138.
horses, 112, 113, 169.
Huahine I., 200.
Hughenden, 123.
Humboldt Current, 28, 311, 328,
Hume Reservoir, 143.
Hunter R., 126–8.
Huon R., 136, 138.
Hydro-electric power, 126, 133–4, 139–40, 175–6, 263, 268, 282–4, 302.
Ichang, 36, 231, 239, 243.
Inca civilization, 325.
Invercargill, 174.
iodine, 335–6.
Ipoh, 67.
Ipswich, 126.
Irawadi R., 221.
iron, 65, 129, 147, 336.
irrigation, 45, 70, 76, 113–14, 125, 143–4, 216, 268, 277, 286, 290, 296, 299, 300–2, 304, 309, 312, 325–6.
Japan Current, 28, 48.
— Trench, 6.
Japanese migration, 34, 182, 208, 219, 245, 256, 262.
jarrah, 97, 148–9.
Java, 9, 18, 23, 34, 58, 70, 72, 74, 76.
Kaimanawa Range, 156.
Kalgan, 246.
Kalgoorlie, 115, 150.
Kamchatka, 8, 48.
Kanai Plain, 251.
Kangaroo I., 91.
kangaroos, 108.
kapok, 70, 76, 82, 193.
karri, 148–9.
Kauai, 204.
kauri, 163, 165, 173, 180.
Kermadec Is., 9, 13.
— Trench, 13.
Kiau-chau, 242.
Kilauea, 206.
Kilmore Gate, 90, 130.
King R., 137.
Kiushiu, 250, 255.
Koeppen's belts, 26.
Kobe, 260.
konas, 203.
Korea, 262.
Kosciusko Plateau, 129, 130, 132; Mt., 130.
Kuala Lumpur, 65, 67.
Kuen Lun Mts., 229.
Kurile Is., 6, 16, 48.
Kuro Siwo, 28, 253.
Kusaie, 207.
Kwanto Plain, 251.
Kwatelene, 211.
Kyoto, 260.
Labuan, 68.
Ladrone Is., 207–8.
Lake George Gap, 90, 129.
La Paz, 46, 331.
Launceston, 112, 141.
Lautoka, 193, 195.
lead, 83, 182, 317, 331.
Legaspi, 220.
Lele, 207.
Levuka, 193.
Lhasa, 46, 247.
Lima, 329.
Lismore, 127.
llamas, 313, 330.
Loddon R., 144.
loess, 89, 236, 309.
Lofty, Mt., 146.
Longreach, 123.
Los Angeles, 292, 297.
Luchow, 243.
Luchu Is., 8.
Luzon, 214, 218.
Lyell, Mt., 139.
Lyttelton, 173.
MacDonnell Range, 121.
Mackay, 124.
Mackenzie R., 52.
MacKinley, Mt., 6.
Macleay R., 127.
Macquarie R. and Harb., 136.
Maffra, 131.
maize, 43, 44, 70, 76, 105, 131, 182, 217, 226, 331.
Makatea, 213.
Malacca, 65–6.
malaria, 37, 80, 120, 187, 232.

Malayan migration, 30, 32, 56, 219–20.
Malekula, 183, 186.
mallee, 87, 97, 101.
Mamberano R., 78.
Manapouri, Lake, 154.
Manchu, the, 247.
mandioca, 322–3.
Mangareva, 213.
mangroves, 72–3, 82, 119, 123, 221, 320, 324.
Manila, 36, 219.
Maoris, the, 19, 170–1.
Marianne Is., 11, 207.
— Trench, 6.
Marquesas Is., 11, 37, 208.
Marshall Is., 11, 13, 211.
Maryborough, 125–6.
Maui I., 202, 204.
Mauna Kea, 201; Loa, 201.
meat industry, 112, 121, 169, 173–4, 176.
Medellin, 324.
Mekong R., 3, 221.
Melanesians, 80.
Melbourne, 42, 134.
Merced, 295.
mercury, 182, 316–17.
Mersey R., 138.
mestizos, 314–15, 325.
Midway I., 11, 200.
Mildura, 114, 144.
Milford Sound, 157.
millet, 245.
Mindinao, 214, 219.
minerals (*see also under names*), 50, 77, 83, 119, 125, 182, 241, 249, 255, 269, 275, 287, 304, 312, 316, 326, 335.
Mitta R., 130.
Modesto, 295.
Mojave Desert, 294, 297, 299.
Mollendo, 330–1.
Mongols, the, 245–7.
montana, 320, 326, 331.
Moorea I., 189, 199, 200.
Mortlock Is., 207.
mountain systems, 2–5, 9–11, 49, 50, 54, 59, 68, 78, 86, 89, 91, 127, 129, 153–4, 156, 179, 187, 190, 215, 221, 227, 229, 251, 265, 277, 289, 304, 307–10, 319–20, 332.
Murray R., 106, 113–15, 132, 141–5.
Murray-Darling Basin, 91, 141–4.
Murrumbidgee R., 143.
Musgrave Range, 121.
musk-oxen, 271.
mutton birds, 108.
Nagasaki, 261.
Nanking, 243.
Napier, 174.
Nassau Mts., 78.
Nauru, 212.
Navajo Indians, 303.
naval bases, 66, 196, 205, 243, 262, 305.
Nelson, 175.
New Caledonia, 11, 179–83.
Newcastle, 129, 147.
New England Plateau, 126.
New Hebrides, 11, 183–6.
New Plymouth, 174.
New Westminster, 284.
Ngauruhoe, Mt., 156.
nickel, 182.
nitrates, 40, 329, 335, 336.
Nobi Plain, 251.
Nome, 271.
Nomuka, 198.
Normanton, 123.
Nouméa, 181–2.
Nukualofa, 197.
Nukuhiva I., 208.
Nullarbor Plains, 91, 150.
Oahu I., 201, 202, 204.
oats, 52, 105, 164, 280.
ocean floor, 2, 4–18, 54, 151.
— currents, 13, 26–9, 48, 92, 253, 274, 311, 328.
Ocean I., 212.
oceanic islands, 11, 17.
Ogden, 299.
Okanagan Valley, 287–8.
olives, 43, 100.
Omeo Gap, 90, 130.
Orbost, 131.
Oregon, 280.
Oruro, 331.
Osaka, 260.
osmiridium, 83.
Otago Plains, 153.
Otway Range, 135.
Ovalau I., 193.
Owen Stanley Mts., 78.
oysters, 168.
Pago-Pago, 196.
Palembang, 77.
Palmerston North, 175.
Panama Canal, 305–6.
pandanus palms, 82, 211–13.
Papeete, 200.
paper-pulp, 138, 281.
Papua, 16, 79, 83–5.
—, Gulf of, 78.
Papuans, the, 79, 80, 83, 85.
Patagonia, 48.
paw-paws, 204.
peaches, 43, 100.
Pearl Harbour, 205.
pearls, 120, 149, 213.
pears, 100, 138, 280.
Pekin, 24, 242.
pelagic deposits, 7.
Pelew Islands, 11, 206.
Penang, 67.
peons, 302.
pepper, 226.
Perth, 42.
petroleum, 77, 239, 292–3, 296, 326, 328.
Philippines, the, 8, 34, 214–20.
phosphates 200, 206, 212–13.
pigs, 113, 169.
pine-apples, 70, 100, 193, 203–5.
pines, 82, 99, 248, 274, 334.
Piura, 327, 329.
platinum, 316.
plumage, 82, 86.
plums, 43, 100, 280.
Pnom Penh, 228.
Polar Current, 28.
Polynesian migration, 1, 16, 19, 31–3, 194, 196.
Ponape Is., 207.
population, 17, 33, 34, 70–2, 81, 115–17, 124, 129, 131, 170–1, 181–2, 188, 192, 194, 196–7, 201, 207–8, 212, 214, 219, 223, 229, 239–41, 246, 254, 256–62, 314, 325.
porcelain, 239, 259–60.
Port Augusta, 147.
Portland, 135, 285.
Port Moresby, 84.
Port Nicholson, 173.
Port Pirie, 146.
Port Wilmington, 296–7.
potatoes, 70, 83, 137, 164, 272, 312.
Potosi, 331.
Puget Sound, 277–8, 284.
Puket, 227.
pumice, 156, 164.
Purani, R., 78.
Quechuas, the, 314.
Queenstown, 140.
Quito, 36, 324.
Rabaul, 84.
rabbits, 109.
racial types, 16, 19, 29–34, 40, 50, 55–6, 58, 79, 80, 85, 109, 120, 135, 171, 181, 184, 188, 192, 194, 204–5, 208, 211, 219, 221, 244–7, 258–9, 271, 274, 302–3, 313–15, 327.
railways, 91, 120, 123, 129, 147, 172, 228, 249–50, 257, 262, 267, 276, 285, 287, 294, 305, 317, 319, 329–30.
Rarotonga I., 198.
rattans, 61, 63, 82.
Raukumara Mts., 156.
reindeer, 271.
Renmark, 114, 144.
resin, 61.
rice, 39, 44, 62, 67, 70–71, 76, 119, 193, 204, 216–17, 221, 224–7, 238, 254, 262, 296, 327.
Richmond R., 127.
rimu, 164.
Riobamna, 324.
Risdon, 140.
Riverina, 142.
'Roaring Forties', the, 23.
Rockhampton, 123, 125–6.
Rocky Mts., 3, 5, 265, 276.
Roosevelt Dam, 300.
Rotorua, 156, 175.

Ruahine Mts., 156.
Ruapehu, Mt., 156.
rubber, 62, 64–7, 70, 76, 82, 193, 226, 311, 324, 331.
rye, 23, 52, 254.
Sacramento, 17, 295, 297.
sage-brush, 297, 301.
Saghalien I., 23, 250.
sago, 83.
Saigon, 228.
Sale, 132.
salmon, 47, 168, 275–6.
salt, 147; saltbush, 97, 149.
Salt Lake Basin, 5.
— — City, 42, 298.
Salwin R., 221.
Samoa, 13, 190, 192, 194–7.
San Antonio, 42.
San Francisco, 42, 294, 296.
San Joaquin, 17, 293–4.
— — River, 292.
Santa Barbara, 295.
Santo, 183.
Sarawak, 68.
Savaii, 194, 196.
Scottsdale, 141.
seals, 168, 276.
Seattle, 24, 284.
Segond Channel, 186.
Selkirk Mts., 289.
Seoul, 262.
Sepik R., 79.
sequoias, 291.
sesamum, 226.
Shanghai, 24, 36, 231, 239, 242.
Shantung, 229, 241, 243.
sheep, 45, 104, 110–11, 126, 131, 137, 142, 166, 169, 287, 297, 304, 330.
Shikoku, 250.
shipbuilding, 129, 260–1.
Sicuani, 329.
Sierra Nevada, 5, 289.
Si-Kiang R., 236, 240.
silk, 238, 241–4, 258, 260.
—, artificial, 138, 259, 282.
silver, 50, 83, 139, 146, 182, 297, 301, 316, 328, 331.
Singapore, 36, 65–6.
Singkep I., 77.
sisal, 76, 82, 204, 262.
Skeena R., 276.
Snake R., 297–9.
soap, 187.
Society Is., 189–90, 199, 200.
Solomon Is., 11, 180, 186–8.
Sonoran Desert, 299.
Southern Alps, 153, 155.
South Esk R., 136.
Southland Plains, 159, 164.
Spencer Gulf, 91.
spices, 67, 82–3, 86, 200, 226.
spinifex, 97.
Spokane, 287.
Stanovoi Mts., 3.
steel, 129, 239, 261.
Stewart, B.C., 277.
— I., 154, 168.
Stockton, 294–5.
Strahan, 141.
Sucre, 331.
sugar, 39, 67, 70, 76, 82–3, 105, 107, 124–7, 191–3, 200–5, 217–18, 220, 226, 262, 304, 322, 327, 331.
sugar-beet, 131.
sulphur, 317.
Sumatra, 58, 72, 75–7.
Sungai Golok, 228.
Suva, 192–3.
Swatow, 243.
Sydney, 24, 42, 132.
Tabmo R., 130.
Tacna, 329.
Tacoma, 285.
tagua-nuts, 323.
Tahiti, 13, 37, 199, 200, 210.
Tamar R., 138, 141.
Tamworth, 127.
tapioca, 62, 70, 76, 82, 327.
Taranaki, 157.
Tararua Mts., 154.
Tarawera, Mt., 156.
taro, 194, 198, 200, 204.
Tasman, Abel Janzoon, 69, 191.
— Gl., 153.
Taupo, Lake, 156.
Te Anau, Lake, 154.
tea, 44, 70, 76, 82, 193, 238, 243, 254–5.
teak, 38, 70, 76, 226.
Tehachapi Pass, 294.
Tehuantepec, 5.
Tenterfield, 127.
Téoudie, 183.
terrigenous deposits, 7.
Terror, Mt., 8.
thermal regions, 156, 251.
Thompson Trough, 151.
Tian Shan Mts., 3.
Tibet, 3, 50, 246, 247.
Tientsin, 242.
timber, 63, 149, 173, 280–1, 283, 287, 324, 326.
tin, 65–7, 77, 120–7, 139, 227, 316, 331.
Titicaca, Lake, 5, 307.
tobacco, 43, 70, 82, 105–6, 119, 204, 217–18, 226, 255, 262, 331.
Tokyo, 9, 261, 263.
Tonga Is., 190, 192, 197–8.
— Trench, 13.
Tongariro, Mt., 156.
Tongatabu Is., 197.
Toowoomba, 127.
Torrens, L., 91, 123.
Townsville, 123, 125.
trepang, 86.
Tronador, Mt., 307.
trout, 167.
Trujillo, 327, 329.
Tsing-tao, 242.
Tuamotu Is., 11, 13, 212.
Tulagi, 188.
tundra, 51–2, 248, 271.
tungsten, 65, 316.
Turama R., 78.
turnips, 164.
turtle-shell, 206.
Tuscarora Deep, 6, 151.
Tweed R., 127–8.
typhoons, 215, 232–3, 253.
ulabo, 82.
Upolu, 194, 196.
Urga, 42, 246.
Utah, 45, 297.
Valdivia, 46, 312, 332.
Valparaiso, 42.
vanadium, 317, 328.
Vancouver, 274, 281–4.
Vanua Levu, 190.
Vavau Is., 197–8.
vegetables, 70, 254, 295.
Verkhoyansk, 248.
Victor Emanuel Mts., 78.
Victoria Land, 5.
—, B.C., 46, 284.
Vila, 186.
vines, 100–1, 128.
Viti Levu, 190, 193.
Vladivostock, 46, 249.
volcanoes, 3–13, 54, 135, 156, 178, 186, 189–208, 215, 251, 274, 307.
Waikato Valley, 158.
Waikerie, 144.
Wallaroo, 146.
Wanganui, 175.
Warwick, 127.
Washington, 287.
Wellington, 159, 173.
Wenatchee Valley, 287.
Westport, 175.
whaling, 168, 174.
wheat, 43, 52, 101–5, 131, 141–2, 146–7, 149, 164, 166, 168, 174, 245, 250, 254, 280, 287, 295, 297.
Whitney, Mt., 5, 289.
Whyalla, 147.
Willamette Valley, 278.
wine, 146.
Winnipeg, 46.
wire, 129.
wool, 112, 135, 141, 142, 145, 147, 173–4, 176, 326.
Wuhu, 239.
Wyndham, 121.
Yablonoi Mts., 250.
yaks, 50.
Yallourn, 133–4.
yams, 82, 194.
Yang-tse-kiang R., 3, 17, 229–32, 236, 238–40.
Yap Is., 207.
Yarra R., 134.
Yawata, 261.
Yezo, 34.
Yokima Valley, 287.
Yokohama, 260–1.
Yukon Valley, 271–3.
Yuma, 300.
yungas, 309, 330.
Yunnan Mts., 229.
zinc, 83, 139–40, 147, 227, 331.

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